FOOD TECHNOLOGY

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April, 1956 Volume 10, Number 4

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ANNUAL MEETING ANNOUNCEMENTS . . .

PREVIEW OF THE 1956 PROGRAM

"We are now an organization of mature stature and of great importance to the food industry of the nation. The expenditure of one-fourth of the American family income on food—amounting to 67 billion dollars a year—prompts us to recognize our importance and responsibilities," states Dr. L. E. Clifcorn, president of the Institute of Food Technologists, in saluting the biggest event of the food technologist's year, the annual meeting of the Institute of Food Technologists to be held in St. Louis, June 10-14, 1956.

The program for the June meetings is now complete. Mr. C. M. Harrold of the Charles M. Harrold Company, St. Louis, and Dr. R. J. Sumner, Anheuser-Busch, Inc. of the same city jointly head up the June proceedings. Advance information supplied by Harrold and Sumner portend an outstanding meeting. Worthy of a special spot on the calendar of food technologists—and all who are interested in the handling, processing, or distribution of food—are the following:

General Events

June 10: 4 p.m. Press Conference—Room 5, Sheraton-Jefferson Hotel, St. Louis. Interviews can be arranged with the leading food industry executives and food research leaders of the U.S.A. and overseas nations.

June 13: 8:30 p.m. "Moonlight and Magnolias." A trip on an antebellum river packet down the Mississippi. The S.S. Admiral will provide IFT'ers a glimpse of old river days in air-conditioned, streamlined modern luxury surroundings. Dancing and refreshments.

Technical Events

June 11: "Proposed Legislation on Chemicals in Foods"—an address by Representative A. L. Miller, M.D., Member of Congress from Nebraska. Representative Miller has an extensive background in food legislation and has introduced important bills on this subject in our National Legislature.

Also on June 11: Symposium in Commemoration of the 50th Anniversary of the Food and Drug Law. This meeting features Representative Miller of Nebraska, and Food and Drug Commissioner George P. Larrick; also on the program are Eugene H. Holeman, Superintendent of Food and Drugs, State of Tennessee, Howard Prentice of the Proprietary Association and Henry A. Lepper of the Association of Official Agricultural Chemists. The symposium promises to be one of the outstanding conferences of the year. Dr. F. N. Peters, Quaker Oats executive, will chairman the conference.

Technical Sessions

June 11: Dr. C. R. Stumbo chairmans an important session on microbiology, with special reference to the resistance of bacterial spores to thermal processes, including Canning Enemy No. 1 P.A. 3279.

June 12: Dr. B. L. Oser is moderator for a panel discussion that will cover many phases of the current status of chemicals in foods—one of the most lively topics in the food field today.

June 12: Dr. Walter Maclinn leads a probe into the education of food technologists for industry positions. Such questions as where do food technologists go and what do they earn will be answered.

June 12: Chairman I. T. Hutchings and his group of speakers on food engineering will cover what is new and interesting in the field of food machinery and automation. Without modern developments in food machinery our proud boast of being the best-fed nation on earth would quickly become empty.

June 12: Dr. W. M. Urbain leads the session on meat. Studies on meat, "the heart of the meal," range from methods to inhibit fat rancidity to those relating to stabilizing meat color. The problem of meat tenderness also comes in for analysis.

June 13: Colonel John D. Peterman has assembled a group of outstanding Armed Forces food and nutrition researchers concerned with bettering the rations of the G. I.—on land, on the sea, in the air. Lt. Colonel A. A. Taylor, Air Force, speaks on "New Foods at Altitude"—or feeding problems "up in the wild blue yonder."

June 13: Dr. Bruce Morgan chairmans a program that pegs progress on that challenging and complex problem "radiation preservation of food." Oregon workers will describe their studies on utilizing heat in conjunction with radiation—a method that seeks to bypass radiation damage.

June 13: Citrus products receive full attention this year under the chairmanship of C. W. Dubois.

June 13: Dr. E. E. Lockhart and his speakers for the session on sensory testing will go into such matters as detecting flavor changes in products due to pesticides applied during the crop stage, grading toughness-tenderness in beef, and consumer attitudes toward imitation pepper.

Many other equally stimulating sessions are on the agenda for June 10-14 food research council at St. Louis. Cereal technology under chairman Robert A. Larsen, general food research studies with D. E. Brady wielding the gavel, canning studies with George W. Beach as leader, fermentation advances, Robert F. Light, chairman, and dehydration progress under the leadership of John H. Nair are included. Dr. Donald K. Tressler, widely known for his life-long services and

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(Continued from page 2)

contributions to many phases of food research, leads the sessions on fruits and vegetables. In Dr. L. W. Elder's session (packaging and general research papers) an apparatus designed for the electrochemical estimation of flavors in vegetables will be explained and illustrated. Flavor, the most elusive and mysterious attribute of the many attributes that make up food, will receive attention in many other papers presented at the St. Louis meetings.

HOTEL RESERVATIONS

For the information of those interested in making reservations, the convention hotel for the IFT meetings, June 10-14, 1956, is the Sheraton-Jefferson Hotel in St. Louis, Missouri. Accommodations are also available at other hotels—the Lennox, Mayfair, and Statler. Reservations made through the St. Louis section of the IFT may be mailed to: St. Louis Section IFT, Room 406, 911 Locust Street, St. Louis 1, Missouri.

BOOKS . . .

ADVANCES IN FOOD RESEARCH, VOL. VI. Edited by E. M. Mrak and G. F. Stewart—398 pp.; including author and subject inder. Academic Press Inc., N. Y., N. Y., 1955.

The value of this series increases with each new volume of *Advances in Food Research*. Food technologists owe their continued thanks to the editors and contributors for maining the high standards set by earlier volumes. The subjects treated in Volume VI should be of interest to a wider group than those in some previous volumes.

The seven chapters are: Applications of Research to Problems of Candy Manufacture, L. F. Martin (66 pp.); Bacterial Spoilage of Wines with Special Reference to California Conditions, Reese H. Vaughn (43 pp.); Microbiological Implications in the Handling, Slaughtering and Dressing of Meat Animals, John C. Ayres (53 pp.); Microbiological Problems of Frozen Food Products, Georg Borgstrom (68 pp.); Potato Granules, Development and Technology of Manufacture, R. L. Olson and W. O. Harrington (26 pp.); The Thermal Destruction of Vitamin B_1 in Foods, K. T. H. Farrer (57 pp.); Tunnel Dehydrators for Fruits and Vegetables; P. W. Kilpatrick, E. Lowe and W. B. Van Arsdel (59 pp.).

In his discussion of Candy Manufacture, Martin pleads for more research to help this industry learn the "why" as well as the fundamental "how" of candy production. Over 250 references, most of them recent, an excellent introduction and a complete summary give this information to even the casual reader.

Vaughn writes for the microbiologist who is lost in the confused terminology (and thinking) dating back to the time of Pasteur. Drawing on his own unpublished work and giving an extensive bibliography Vaughn contributes to improvement in the taxonomy of acetic acid and lactic acid bacteria.

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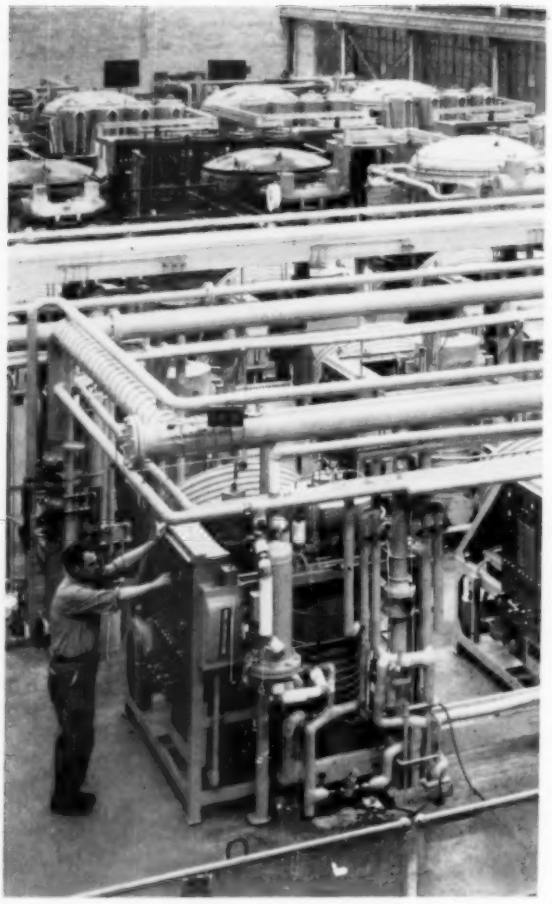

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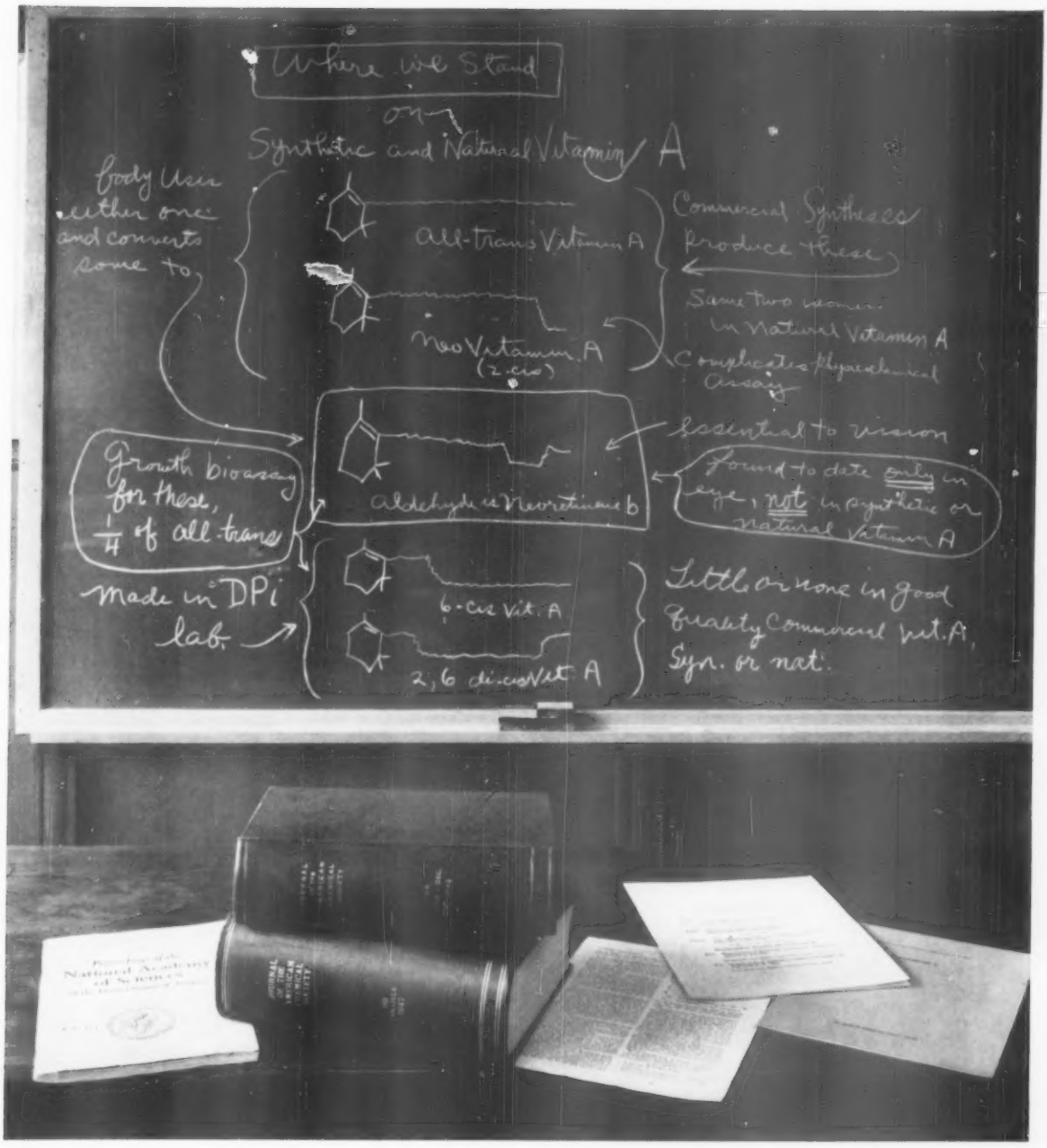
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(Continued from page 4)

The microbiology of meat animals, while limited to consideration of the whole carcass and fresh wholesale cuts, is summarized clearly and simply by Ayres. He starts with a discussion of the defensive mechanism of the animal and considers the ante-mortem, slaughtering, and post-mortem environments. He also lists additional studies needed and suggested improvements in the industry. He recommends that bacteriological standards be established and makes specific recommendations.

Borgstrom treats the microbiology of frozen food products in a different style. His bibliography of over 400 references is the largest in the book and the information is presented strictly as a review with little emphasis on problems still to be solved. The "practical aspects" at the end of this chapter are brief and general. Limited space probably forbade a more quantitative discussion of temperature and microbial limits.

In the short chapter on potato granule manufacture Olson and Harrington give the complete history as well as current status of this product. Quality and evaluation of the granules are well covered.

Farrer applies simple kinetic and physical principles to the study of vitamin B_1 destruction in foods by heat. His survey of published work on this subject shows that in most instances the data are too incomplete to obtain rate constants or activation energies. Where data are available a good correlation is obtained but some factors, such as an initial very rapid rate of vitamin destruction are unexplained by the simple equations used and the present known factors.

Van Arsdel and his colleagues present the principles of tunnel dehydrators and their design and operation in a clearly written chapter. The mathematical background is sketched very lightly and the usefulness of the simple theory shown in many examples. The authors conclude that tunnel driers will continue to be used in most plants for many years to come although there is increasing use of conveyor driers.

The present volume is recommended to all food technologists from students to charter members of IFT. The authors bring us up to date in their respective fields and furnish ample material for further exploration. There are remarkably few typographical errors.

REID T. MILNER
Urbana, Illinois

PROTEIN MALNUTRITION. Edited by J. C. Waterlow. University Press, Cambridge, England, 1955. xiii + 277 pp., 24 plates.

Protein malnutrition is one of the most widespread nutritional disorders in tropical and sub-tropical areas. It is an ill-defined syndrome known as kwashiorkor, malignant malnutrition, infantile pellagra, depigmentation-edema, syndrome, polydeficiency disease, etc. in various regions. Data on the clinical, biochemical, epidemiological and sociological aspects of this disease need to be collected and correlated. Although there is a basic similarity in the syndrome, throughout the world, the differences are many. It is important to know the extent to which these differences are due to method and approach, to complicating deficiencies, or to interpretation.

This volume is essentially a verbatim account of a conference held in Jamaica (1953), the aim of which was "to clarify points of difference and to put up new ideas for discussion and challenge." The four sessions dealt with the biochemistry, pathology, clinical aspects, treatment and prevention of protein malnutrition. It was a "Macy Foundation-type" of conference, with no formal agenda and free and unorganized discussion, and was sponsored by the Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the Josiah Macy, Jr. Foundation.

This book will be fascinating reading for a student of nutrition deficiencies, for he will feel he is personally present at the conference, listening to the frank opinions of the leading experts on this subject, gaining an insight into the ramifications and complexities of the disease, and learning how little is known and how much is not known about it.

To a student of nutrition, foods and world food problems, this book is valuable for the discussions of the plant foods which appear to be implicated in the development of protein malnutrition, and of the foods of plant and animal origin which show promise in the prevention and cure of this important disease.

ROBERT S. HARRIS
Cambridge, Massachusetts

FUTURE MEETINGS FOR FOOD TECHNOLOGISTS

April 8-13	One hundred and twenty-ninth National Meeting of the American Chemical Society, Dallas, Texas
April 11-13	Annual Meeting of the Research and Development Associates, Food and Container Institute, Inc., Hotel Statler, Boston, Mass.
April 23-25	Forty-seventh Annual Spring Meeting of the American Oil Chemists' Society, Houston, Texas
May 12-15	Annual Meeting of the National Independent Meat Packers Association, Palmer House, Chicago, Illinois
June 6-9	**Sixth Annual Convention of the Australian Sections of IFT, Ritz, Leura, N. S. W. Australia**
June 10-14	**Sixteenth Annual Meeting of the Institute of Food Technologists, Sheraton-Jefferson Hotel, St. Louis, Missouri**
June 10-14	Seventy-third Annual National Confectioners' Association Convention, Boston, Mass.
June 18-22	International Congress on Food Distribution, Rome, Italy
June 18-29	Special Summer Program on Perspectives in Food Technology, Massachusetts Institute of Technology, Cambridge
July 9-11	The Second Symposium on "Foreign Chemicals in Foods," Amsterdam, Holland
August 17-25	Tenth International Congress of Entomology, McGill University and the University of Montreal, Montreal, Canada
September 10	The Perkin Centennial, sponsored by the American Association of Textile Chemists and Colorists, Waldorf-Astoria, New York

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NEW CHALLENGES AHEAD AS QUARTERMASTER FOOD AND CONTAINER INSTITUTE FOR THE ARMED FORCES COMPLETES SECOND DECADE OF SERVICE

Symbol for Quartermaster food and container research and development in 1936 might have been three pots and a pan—through no fault of the Quartermaster General. Limited budget for equipment and personnel held plans and projects to a minimum. Those were lean years—remember?

In the 1940's, with a war on, things developed fast. An extensive laboratory, staffed by military and civilian specialists headed by Colonel Rohland A. Isker, matured into a technical organization (the Subsistence Research and Development Laboratory) that sparked systems of rations adapted to the tactical concepts and supply systems of World War II. Our forces in the South Pacific, in Africa, in Europe ate packaged foods, designed in the Quartermaster laboratory, whenever they drove forward beyond the range of Army field kitchens. The C-ration was known around the globe and so was the K-ration—a food package that subsisted men over short periods of time under combat circumstances. The K-ration was one of the great experiments of World War II and it was successful when used as intended, as tide-over food, and looked upon with jaundiced eye when used—or abused—as day-in, day-out food for advancing, or beleaguered, troops.

Colonel Rohland A. Isker, retired . . . pioneered food and packaging research at the Chicago Qm. Laboratory and shaped its course through World War II.

The Qm. Lab of the 40's chalked up far more accomplishments than the items mentioned. Working closely with the food and packaging industries and with food and container scientists all over America it readied hundreds of subsistence items and packages and packs for highly mechanized World War II. Boneless beef, dehydrated vegetables, improved dairy products and better, more rugged packaging denote the range of the efforts. Outstanding achievements on the administrative side were the close cooperation fostered with the food and container industries and the mobilization under the Committee on Food Research of most of the "old pro's" among the food scientists and packaging engineers of the nation. Also growing out of the war years was the motivation in 1946 by Colonel Chas. S. Lawrence and Mr. George Gehman, Commandant and technical director of the QmFCI, respectively, of the Research and Development, Associates, Food and Container Institute.

Colonel C. S. Lawrence . . . instrumental in founding of the Associates, a non-profit industry-academic group whose objective is to facilitate the solution of military food and packaging difficulties.

Today, under the name The Quartermaster Food and Container Institute for the Armed Forces, the "Quartermaster Lab" and its personnel of some 300 people, headed by Colonel J. D. Peterman and Scientific Director Donald K. Tressler, apply latest research techniques to the development for military use of hundreds of food items and thousands of packagi ng items needed by the Armed Forces. Problems come to the Institute from the field of military operations, from military planning groups, and from industry itself in cases where modification of commercial products for ration use or for packaging use is involved.

Dr. Donald K. Tressler, Scientific Director, Dr. Robert G. Tischer, Food Laboratories Director, Colonel J. D. Peterman, Commandant, and Dr. Harry Goresline, Associate Scientific Director, discuss administrative details in an Institute food lab.

The Institute is located on the Quartermaster organizational chart under the Qm. Research and Development Command, Natick, Massachusetts, General C. G. Calloway commanding. Recently, the Command, along with all other military-founded programs, has been intensifying programs designed to anticipate wherever

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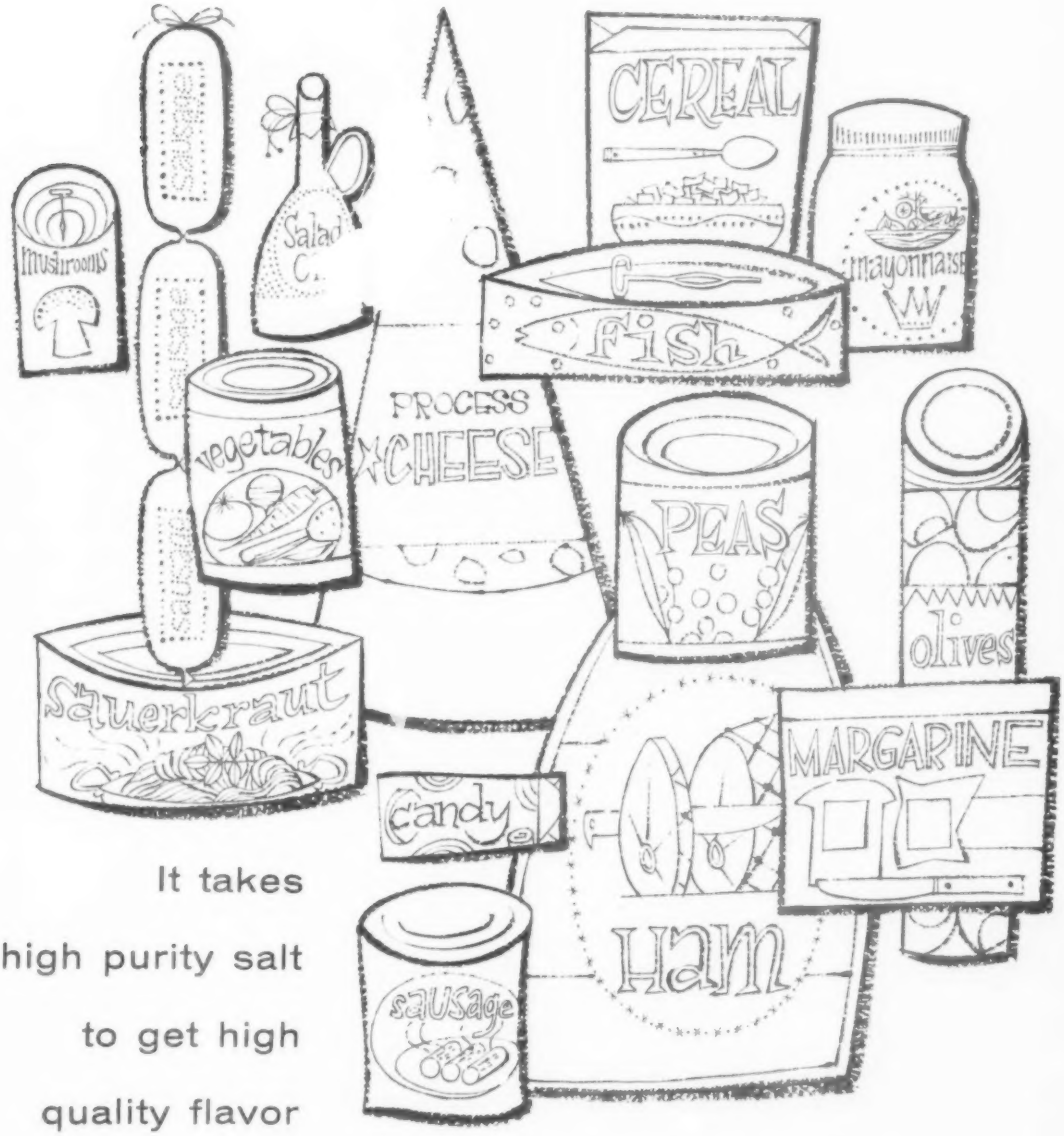

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(Continued from page 8)

possible the demands of warfare of the future. Elements of the pattern have been discussed in military journals from time to time. Dispersion of forces, high mobility, and retention of supply line labor and administration well away from the zone of combat are envisaged. These predicted changes in tactics and logistics have influenced most military research and development objectives and projects. The program of the Institute, for example, has been oriented in the direction of simplified logistics —on precooked unit meals with heavy emphasis on dehydrated foods including meat, on new methods of processing such as radiation preservation, and on supply

Sponsored research enables QmFCI to utilize talent and equipment of industry and colleges for advancement of Armed Forces' projects. Shown here is a set-up for irradiating meat at Swift & Co. laboratory.

by aerial transport media including helicopters (with a direct effect on military packaging). There is added concentration on the attainment, because of the increased "austerity' predicted for military living under atomic-warfare conditions, of adequate nutrition and palatability in the new types of rations and adequate protective qualities in the packaging of the future.

Directing the food phase of the Institute program is Dr. Robert G. Tischer and heading the container projects is Mr. Albert V. Grundy. Focus of concern in both programs is contributing through research and development to increased operational efficiency of our Armed Forces under the concept of dispersed, fast-moving defense forces. The task of directing the food research program includes keeping aware of the relationship of military feeding to other military functions and adjusting rations to manufacturing techniques, transport and storage media, and preparation facilities. The components of other operational systems are of

Lt. Colonel Vic F. Bodner, Assistant Commandant — among his responsibilities is administering a program to coordinate Institute food research and development with Army, Navy, and Air Force agencies.

constant interest in food research and development—for example, how to extend the shelf-life of foods destined for use aboard Naval underseas craft that can range the seven seas without refueling.

The major concern in modern military packaging is aerial delivery. Institute packaging research and development are directed toward the numerous possibilities for achieving in the package or pack itself the properties required for shipment and delivery of supplies by air. Thus, as one example of many, probes into the area of "energy absorbers," that is, cushioning media that will absorb the shock of ground impact of air-dropped supplies are being conducted by the Institute in cooperation with other agencies of the Command and the Department of Defense.

Not new, but certainly intensified, is the military interest in human behavior under changing modes of warfare. One aspect of concern to Institute researchers is the attitude of members of the Armed Forces toward food. Vitally needed are answers to the questions:

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Mr. Albert V. Grundy heads container research and development projects at QmFCI.

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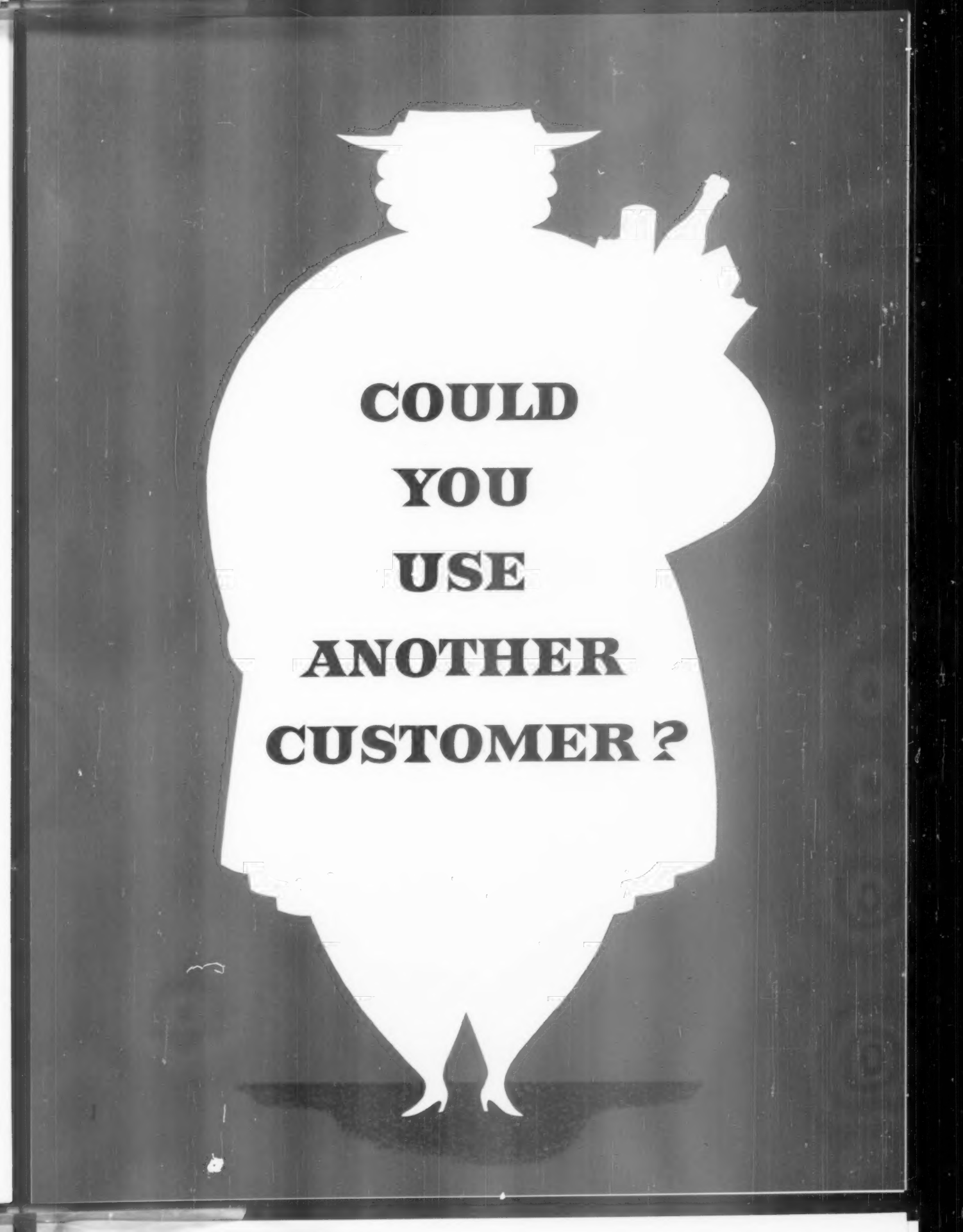
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(Continued from page 10)

what foods? how much? and how prepared? In future warfare stress and monotony may reach extremes. It has been shown that serving the same food or type of food every day—reference the K-ration—can cause a marked deterioration in the attitude toward food. The "psycho-physiology of food acceptance" takes on new meaning as warfare goes to school under the atomic weapons developments now proceeding at such a dizzy pace.

The primary mission of the Qm. Corps is to service the men on the front line—the main line of resistance. As mentioned earlier, predicted modes of combat indicate that the "front line" of the past has become under tomorrow's concept a dispersed, highly mobile "line." With regard to the size of that future task in terms of adapting foods to a simple, austere pattern of supply, it might be pointed out that at peak strength in 1945 food was being supplied the Armed Forces at the rate of 24,000,000 meals a day. What the requirements for food and packaging will be in some future military emergency, no one can say. But it is abundantly clear that many of the problems inherent in changing food logistics have no counterparts in present commercial food and packaging operations. The challenge of the future must therefore be met as in the past—by the food scientists and technologists of private industry and of publicly supported institutions in both the Federal and State governments, and by all other groups with the necessary know-how and know-why resources pertinent to foods and packaging. The mission of the Institute will be to coordinate the technical advances made and concentrate them on the food and container needs of today and tomorrow.

IFT REGIONAL SECTIONS . . .

SPEECHES, SPECIAL EVENTS, NEWS NOTES

THE FOOD INDUSTRY OF ISRAEL[a]

Amihud Kramer, University of Maryland

THE LAND OF ISRAEL is about the size and shape of the state of New Jersey, and yet certain geographical peculiarities favor a diversity of food production seldom equalled by countries less than continental in size. The moderating influence of the Mediterranean provides a practically frost-free climate in the coastal plain, cooler weather in the central mountain range, and tropical conditions in the Jordan rift—which is well below sea level. The transfer of surplus water from the north to the arid south is the key to the full development of the food producing potential of the country.

Much of the lush valley north of the Sea of Galilee is a vast peat swamp. Upon completion of the current drainage project, thousands of acres of very productive soil will be available. The environs of the Sea of Galilee, and the valley to the south, is already a tropical paradise producing such crops as bananas, dates, and winter tomatoes. The pleasant rolling hills of the Galilee to the west are noted for their olives, figs, deciduous fruits, and tobacco. Where the topography is not suitable for cultivation, the natural pasture is being revived to support the growing herds of sheep and cattle. Separating the Galilee from the hills of Samaria to the south is the valley of Jesreel, whose rich black soil provides the feed for a large part of the Israel dairy industry. Besides Israel's foremost crop, citrus, which is localized in a narrow strip of land to the north and south of Tel Aviv, the coastal plain produces a wide variety of other horticultural and agronomic crops. In the narrow valleys and newly reterraced hillsides of the Jerusalem corridor, newly planted orchards of plums, peaches, and apples are growing besides ancient olives, grapes, and apricots. Further south, in the Beersheba area, only winter barley and similar crops can be grown in the rich loess soil under dry farming conditions because of the paucity

Packaging and labeling ca 700 B. C. This jar of olive oil was inscribed with the following "Label": "This jar belongs to Menahem Ben Yehavneh."

of water. Further south to the Red Sea, and east to the Dead Sea, total aridity and/or saline conditions prevent the existence of agriculture unless an ambitious and expensive irrigation project were to bring water to this forbidding fantastic wasteland. The exceptions are the few oases that appear like mirages with their clusters of date palms.

Fish, including shell fish, are caught in the Mediterranean by a modern fleet of vessels operating from Haifa harbor, while fresh water fish are caught in the Sea of Galilee, or grown in artificial fish ponds—a unique development of Israel.

THE PROBLEMS

War shortages and population exchange. Whereas the United States was at war for about 4 years, and other countries for

(Continued on page 16)

[a] Presented before the Maryland Section, IFT, October, 1955. Dr. Kramer spent a year in Israel during 1954-55, as food specialist under the U. S. Technical assistance program.

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(Continued from page 13)

about 6 years, war conditions existed in Israel from 1939 until 1952. Following the Israeli-Arab war in 1948, about half the population, including the great majority of the food producers, were replaced by an approximately equal number of immigrants, practically all of whom had no agricultural experience whatsoever. Although war conditions did stimulate the manufacture of preserved foods, the strong sellers' market and cost plus conditions did not favor cost reduction or high quality. Since 1952, there has been a rapid and consistent improvement in the situation.

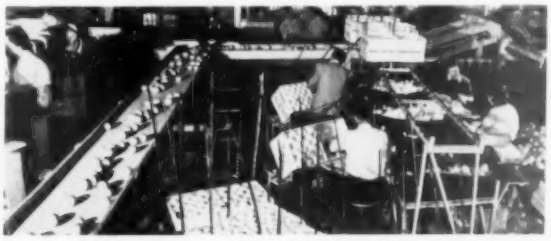
Tnuva dairy in Haifa, producing pasteurized, bottled milk products.

Under the guidance of the older residents, and special agents, many of the new immigrants are becoming productive farmers, while others are developing skills in industrial production. Thus, in recent years, raw as well as manufactured foods have become more plentiful. As different food commodities have become more available, controls have been relaxed or removed altogether. At the same time the consumers have paid more attention to quality, so that government inspection has changed from the policing of rationed foods to controlling such things as wholesomeness and quality.

Capital. Like other underdeveloped countries, Israel needs capital to develop its natural resources. Long term investments as well as short term operating capital are needed to allow a full and rapid development. Although American philanthrophic and grant funds and German reparations are of incalculable assistance, private investment is encouraged by the stable, progressive government. Interest rates are attractive. Hard currency investments may be dollar linked, and a generous portion of the annual profits may be withdrawn in dollars.

Scale of operations. Israel is a small country both in land area and in population. Consequently, only a few operations can be expanded to take full advantage of full scale mass production processes and the full utilization of by-products. For this reason a number of the large food manufacturers have gone into the production of a large number of items. As the industry stabilizes, it is hoped that these firms will concentrate on fewer products, but produce each of these products in greater quantities.

Technical training. Although Israel along with the rest of the world suffers from a shortage of trained technologists, a small core of highly qualified men is striving mightily to raise the quality level of the personnel, equipment, and ultimately the products of the Israel food industry. To mention a few whose work is known in the United States, Dr. J. B. S. Braverman,[b] who is credited with establishing the citrus manufacturing industry in Israel, has recently embarked on the development of a Food Technology department at the Haifa Technion. Dr. Koeffler has developed and improved citrus processing equipment. At the Rehovot Research Station, Dr. Zdenka Samish,



A citrus packing plant.

and R. Littauer are developing food processing storage and transportation laboratories which are assisting the food industry in the solution of practical problems. Within the Israel government, Dr. Feigenbaum has been channeling foreign U. S. and U. N. specialists' talents for the benefit of the industry as well as sending trainees abroad for specialized study.

The work of the above scientists has been supplemented by others who received their training in the United States or Europe, and their efforts to train younger personnel in the country are beginning to be felt.

Work productivity and quality control. The Israel government and Industry realize fully that U. S., U. N., and German reparation funds are temporary and that the current adverse balance of trade must be balanced within the next few years. If exports are to balance imports, Israel products must be of such quality and cost as to be able to compete on world markets. Thus programs to improve work productivity, and to install quality control have been embarked upon with great enthusiasm, and are beginning to show their effects. A newly reorganized Food Inspection Service regulates quality in accordance with standards issued by the Israel Standards Institution. Products designed for export must also pass inspection on the basis of standards promulgated by the importing country.

THE FUTURE

Judging on the basis of current progress, Israel should develop a positive trade balance in the near future. Not that it will ever become self-sufficient in all foods. Because of the limited land area the great bulk of the cereals and oil seeds will probably be imported in the future as it is at present. Such imports however, can be balanced by the export of such crops as can be grown and processed under unusually favorable conditions. The jaffa orange, for example, rightly enjoys the reputation of being the highest quality orange on the European market. It is planned to double the present export of some 8 million cases annually over the next decade. The grape thrives in all parts of the country, reaching a sugar content that has not been equalled elsewhere. Israel wines and liquors of uniformly high quality should therefore find a ready market particularly for sacramental purposes. Once storage and transportation problems are solved, a substantial list of out-of-season fresh fruits and vegetables can be shipped to Europe. The canning and confectionery industries can continue to develop the export of high quality specialty items. The advantages of producing high quality products may be demonstrated by the rapidly growing peanut industry, where the high quality Israel-grown peanuts are exported, whereas low quality

(Continued on page 18)

[b] Author of *Citrus Products*, Interscience Publ., New York, N. Y., 1949.

They VAPORIZE tinplate to improve it

Although this may look like a peaceable scene, it's not. The instrument shown above — an emission spectograph—vaporizes a sample of metal in a high voltage. This is an important piece of testing equipment in United States Steel's Applied Research Laboratory.

By vaporizing small samples of metal, the emission spectograph performs one step in ascertaining types and amounts of constituents in a given metal. By controlling the composition of the steel, it is possible to attain the most ideal type of steel strip for tinplating purposes. The finest quality steel means finer tinplate, thus, better protection for products packed in tins.

The emission spectograph is only one step in many taken by United States Steel research chemists in the constant search to improve tinplate for canners and packers throughout the world.

USS TINPLATE

UNITED STATES STEEL CORPORATION
525 William Penn Place Pittsburgh 30, Pa.

UNITED STATES STEEL

(Continued from page 16)

nuts are imported to be used for oil and feed together with the locally grown culls.

With its favorable climate, fertile soil, and an alert and industrious population, the Israel food industry has every reason to hope for the achievement of high food standards for its population and a positive balance between food imports and exports.

NORTHERN CALIFORNIA . . . .

The Section's February 23rd meeting held at the Three Little Swiss, 530 Broadway, San Francisco, saw the 1956 Program Committee break with tradition by selecting an outstanding speaker in the field of business management. Mr. Douglis Watson, Principal, McKinsey and Company, one of the nation's foremost business engineering firms, was the kick-off speaker in this revolutionary approach to professional improvement. He dealt with the "tools" of management and, most important, revealed the food technologist's function in this management field.

Mr. Walter Guild, President, Guild, Bascom and Bonfigli Advertising Agency, is to address the April 19th meeting. He will deal, in detail, with the various major functions of business management as outlined first by Mr. Watson at the February 23rd meeting. Tentative title of Mr. Guild's address is, "What A New Food Product Must Have To Be Marketable."

The Delta Sub-Section held a meeting on January 12. Dr. Stanton Cohn spoke on "Internal Radiation Hazard from Plants and Animals Exposed to Fall Out Nuclear Detonation."

MARYLAND . . . .

The Section held its February meeting on Friday, February 10. The guest speaker Dr. W. S. Arbuckle, a product of Purdue University and the University of Missouri, who has had wide experience in the dairy business, discussed "What is New in Dairy Technology?"

He traced the development of the dairy industry and dairy education and pointed out that as a technologically-developed industry, the dairy industry is a recent one. He discussed the introduction of condensed milk, pasteurization, homogenization, Vitamin D, the abandonment of daily deliveries, new packaging techniques, and high temperature pasteurization. He explained that although there has been a decrease in the number of dairy farms in the country since 1944, there has actually been an increase in milk production. He called attention to the interesting fact that the United States is not one of the top countries in the consumption of most dairy products. Finally, he showed slides showing recent innovations in dairy technology, such as farm milk tanks, milk tank truck transportation, layouts for high temperature processing of milk, and some interesting slides showing the microscopic structure of ice cream.

Following Dr. Arbuckle's talk, there was a lively discussion, after which Mr. C. E. Connelly showed a film on dairy manufacture, produced by the Koontz Creamery, of Baltimore.

MOHAWK VALLEY . . . .

The annual business meeting of the Section was held at the Fort Rensselaer Club, Canajoharie, New York on Tuesday, December 6, 1955. Elected to office were:

Theodore F. Irmiter, Chairman
Michael E. DeBenedictus, Vice-Chairman
Louis H. Anderson, Secretary
Dan Theokas, Treasurer
Michael Glickstein, Counselor

Following the business meeting, two interesting films were shown. The first, entitled "Functional Photography in Industry" dealt with the uses of photography in research, production, quality control, personnel training, and sales. The second film "Glass and You" outlined the history of glass and showed some modern industrial glass manufacturing methods, glass craftsmen and artisans at work and some of the many present day uses of glass.

PHILADELPHIA . . . .

The March meeting of the Section was devoted to a Symposium on Instrumentation. Mr. William J. Scarlett, Minneapolis-Honeywell Regulator Co. was the moderator. Panel members and their topics were:

Mr. R. B. Reynolds, Taylor Instrument Co.
"Fundamentals of Measuring Systems."

Mr. L. M. Richardson, The Foxboro Co.
"What is Available for Process Control?"

Mr. T. Workman, General Electric Co.
"Applications of Radiation to the Food Industry."

Mr. E. J. Guilfoy, Radio Corporation of America.
"Metal Detection in Food Products and Beer and Beverage Inspection."

At the February meeting, to familiarize the educational institutions with the affairs of IFT, we had as guests Drs. Floyd Tyson, Arthur Osol, Edward Cox and T. O. Jones, who represented the Chemistry Departments of the local colleges.

The featured speaker of the evening was Dr. Amihud Kramer, Professor of Horticulture at the University of Maryland, who spoke on the "Practical Applications of Statistical Quality Control in the Food Industry."

DIXIE . . . .

On February 19, Mr. John J. McManus, retired Chief of the Atlanta District, Food and Drug Administration, and Mr. James Pearson, Present Chief of the Atlanta District, spoke to the Section about the Food and Drug Administration during its early days of de-

(Continued on page 20)

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(Continued from page 18)

velopment and about present activities. Mr. McManus' experience with the Food and Drug Administration extends back until 1908 so that he had an opportunity to observe the pioneer work which Dr. Wiley and other early leaders in the food and drug field did. Mr. McManus described conditions which led to enactment of the Food and Drug Law of 1906 and described some of the early landmark cases, many of which he took part in, and the gradual changes that took place in the food and drug work over the years. Mr. Pearson who is being promoted from Chief of the Atlanta District to Chief of the Federal-State Division, Washington, D. C. talked about present activities of the Food and Drug Administration. He pointed out that the food and drug industries are more complex industries today, that 50% of the medications on the market today were unknown 15 years ago, that there has been a phenomenal expansion in baby foods, frozen foods, and in processed foods in general and that adequate enforcement of the Food and Drug Laws not only affects people presently living but probably even the unborn. Mr. Pearson pointed out that much of the progress that has been made has been attained through the help and cooperation of industry. There were 49 members of the Section in attendance.

CHICAGO . . . .

At 6:00 p.m. the traditional social period was held in the Illinois Room amid much "hello-ing," toasting and small talk. Dinner was served in the Chicago Room and the 100 members and 9 guests returned to the Illinois Room for the second meeting of the new year.

Col. C. S. Lawrence presented the Gerber Award to Dr. Austin C. Wagenknecht. The Award, consisting of a $6,000 fellowship, was granted to Dr. Wagenknecht on the basis of his prior academic accomplishments and in view of the research program he presented. Dr. Wagenknecht will investigate "The Enzymology and Biochemistry of Vegetable Lipids" at the University of Illinois.

C. K. Wiesman, Program Chairman, announced that the March meeting will be held at the Quartermaster Food & Container Institute. V. O. Wodicka is in charge of arrangements and a special invitation is being made to the member's wives.

Mr. Wiesman introduced Mr. W. E. Graham, Division Manager of Research, Crown Cork & Seal Co., who spoke on "Food Aerosols." Mr. Graham noted that the term "aerosol" is being loosely applied to many products which do not properly fall under that classification e.g. whipped cream, hair lacquer and paints. It would be more correct to say that these products are of the "pressure dispensed" type; however, the misuse of the term "aerosol" has become so widespread that the world has actually taken on a new connotation. Illustrating his talk with slides, Mr. Graham pointed out the various packaging techniques, types of containers and valve designs.

Approximately 20 food products have been investigated as to whether or not they can be satisfactorily pressure dispensed. At the present time products can only be dispensed as sprays or in whipped form; this generally limits pressure dispensing to only those food products which are usually used in whipped form.

NORTHEAST . . . .

The happy news that Dr. Bernard E. Proctor has been selected to receive the Nicholas Appert Award, the the distinguished honor given each year by the Chicago Section of IFT, came in during late February. Needless to say the Section is extremely proud of the distinction that has come to its first president. Background facts on Dr. Proctor's education and career will appear in the May issue of FOOD TECHNOLOGY.

The presentation will be made at the 16th annual meeting of the IFT which is being held in St. Louis, June 10-14. Dr. Proctor will respond to the Award with an address entitled "Food Horizons" at the General Session on Wednesday, June 13, in the Gold Room of the Sheraton-Jefferson Hotel, St. Louis, the site of the meetings.

PERSONNEL

Promotion of Dr. Harry E. Goresline to the post of Associate Scientific Director, Qm. Food and Container Institute for the Armed Forces, 1819 W. Pershing Road, Chicago, has been announced by Col. John D. Peterman, commandant of the Institute, and Dr. Donald K. Tressler, Scientific Director. Dr. Goresline, a resident of Park Forest, Ill., has served at the Institute since July 1952 as Chief of the Institute's Stability Division and most recently as Associate Director of Food Laboratories. Receiving his training in chemical engineering at Oregon State College, Corvalis, Oregon, Dr. Goresline was awarded a doctorate in Sanitary Bacteriology and Food Chemistry at Iowa State College, Ames, Iowa. Dr. Goresline has spent many years of his professional life in food research, specializing during the first phase of his career on problems relating to the chemistry and bacteriology of the poultry industry. He has held responsible posts with various research agencies of the U. S. Department of Agriculture, and during World War II was closely identified with the effort to improve dehydrated eggs.

Dr. Goresline will be concerned in his new duties with technical phases of Chicago Quartermaster Institute activities with special responsibilities in the field of applications engineering. In this latter area he will direct investigations and studies designed to coordinate the findings of the food laboratories with the food industries who manufacture Armed Forces rations and with the military users.

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IFT ACTIONS AND REACTIONS...

ADDENDUM TO COMMITTEE AND LIAISON REPRESENTATIVE STRUCTURE OF THE INSTITUTE

Additional information on the makeup of IFT committees has now become available. It follows:

Committee on Taste Testing and Consumer Preference

E. E. Lockhart, Chairman — E. H. Hinreiner
E. H. Dawson — W. H. Danker
S. I. Omansky — D. Foster
D. R. Peryam — G. F. Garnatz
I. Fagerson — L. B. Sjostrom
J. Wood

Awards Committee (addition)

R. T. Bohn

Committee on Citrus Products (addition)

C. H. Brokaw — R. W. Kilburn
O. R. McDuff

Liaison Representative to the Food and Nutrition Board—National Research Council

B. E. Proctor

Liaison Representatives to the American Association for the Advancement of Science

C. N. Frey — P. F. Sharp

BRIEF REPORTS FROM IFT COMMITTEES

Dr. S. C. Prescott, Chairman of the Committee on History, reports that his Committee is making progress on the History of IFT. Dr. Prescott presented a paper on the Origin and Early History of IFT at the December meeting of the Northeast Section. The paper will form part of a prologue to the more extended history. All of the early official reports of the Secretary of IFT have been reviewed—but many important facts must be derived from the memory of the early members. (Contributed mementos to this important Committee activity should be sent to Dr. S. C. Prescott, 77 Massachusetts Avenue, Cambridge 39, Mass.)

The interim report furnished by Dr. W. R. Roy, Chairman of the Citrus Products Committee, consists of a report of the activities of two subcommittees.

The Subcommittee on Methodology under the chairmanship of Dr. M. K. Veldhuis, reviewed a citrus industry survey representing 32 laboratory reports from 35 samples and questionnaires. Results indicated the need for more uniform procedures of analyses and were reported at the October meeting of the Florida Section. Current efforts are being expended in development of uniform methods for pectinesterase determinations.

The Subcommittee on Microbiology, under the Chairmanship of Dr. Reese H. Vaughn, is working on a report on "Standard Methods for the Examination of Citrus Products for Coliform Bacteria" which they anticipate presenting at the Annual Meeting in St. Louis. Work is also underway on unified methods for the examination of frozen citrus products for lactic acid bacteria.

Dr. Roy advises that Dr. Vaughn and D. I. Murdock presented a paper on "The Sanitary Significance of Microorganisms in Frozen Citrus Products" at the national meeting of the American Public Health Association in Kansas City. A great deal of interest was displayed by the audience and it was felt that this presentation to Public Health officials would go a long way toward clarifying the confusion which may have existed toward the bacterial picture of frozen citrus products.

TO CHANGE YOUR MEMBERSHIP STATUS

The National IFT *Qualifications Committee*, under the chairmanship of Dr. Roy E. Morse, sets forth the following procedures for changing the status of membership and in obtaining student membership:

1. What does a member do who wishes change of status?

   Answer: On a new application blank fill in *all* details of education and experience acquired since the original application was submitted. Forward the completed blank to the Executive Secretary who will then direct it through the proper channels. No additional endorsements are needed at the time of submitting request for change in status.

2. What is the procedure for obtaining student membership?

   Answer: Student who fulfills qualifications stated in the constitution should fill out membership blank and submit it to faculty member who is also an IFT member. Faculty member will execute application blank stating he knows student to be regularly enrolled student, and will forward executed membership blank to the Executive Secretary for further handling.

THE COMPLEX ROLE OF SWEETENERS IN FOOD PRODUCTS

Physical properties, chemistry, and practical application of sweeteners, both nutritive and non-caloric, were reviewed at the February 15 meeting of the New York Section of the Institute of Food Technologists.

Presenting this portion of the Section's theme for the year—Functional Use of Food Additives—was Dr. Robert Hockett, Associate Scientific Director, Tobacco Industry Research Committee, New York City.

Generally, the primary use of sweeteners in a food product is for flavor effect. Processing would indeed be greatly simplified if sweetness existed as an entity, but this is not the case. Thus the speaker emphasized the importance of other properties introduced by the sweetener—such as solubility, viscosity, fermentability, preservative action, and crystallization.

These effects were illustrated with slides showing physiological, physical, and chemical properties of all

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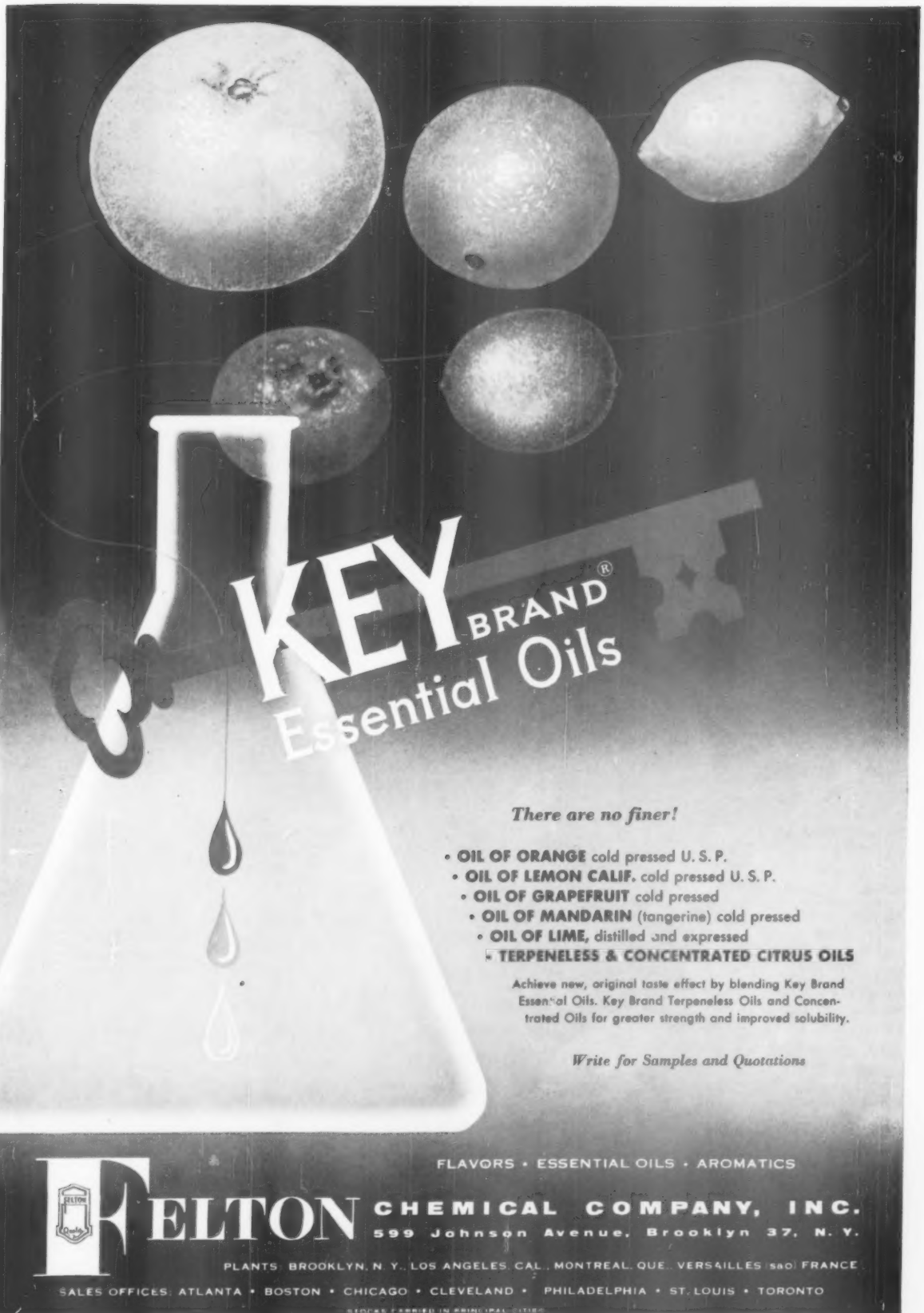
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(Continued from page 22)

sweeteners. An interesting point is the fact that sweetness concentrations are not additive. Thus, if a 10% sucrose solution is added to a 12.7% solution of dextrose (both are of equal sweetness), the resulting mixture is less sweet than sucrose but sweeter than dextrose.

With the manufacture of hard candy, fondant, fudge, and caramel as examples, Dr. Hockett detailed the role of various commonly used sweeteners. Also noted was the use of non-caloric agents in dietetic foods and beverages.

RECENTLY ELECTED MEMBERS OF IFT

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(Continued on page 26)

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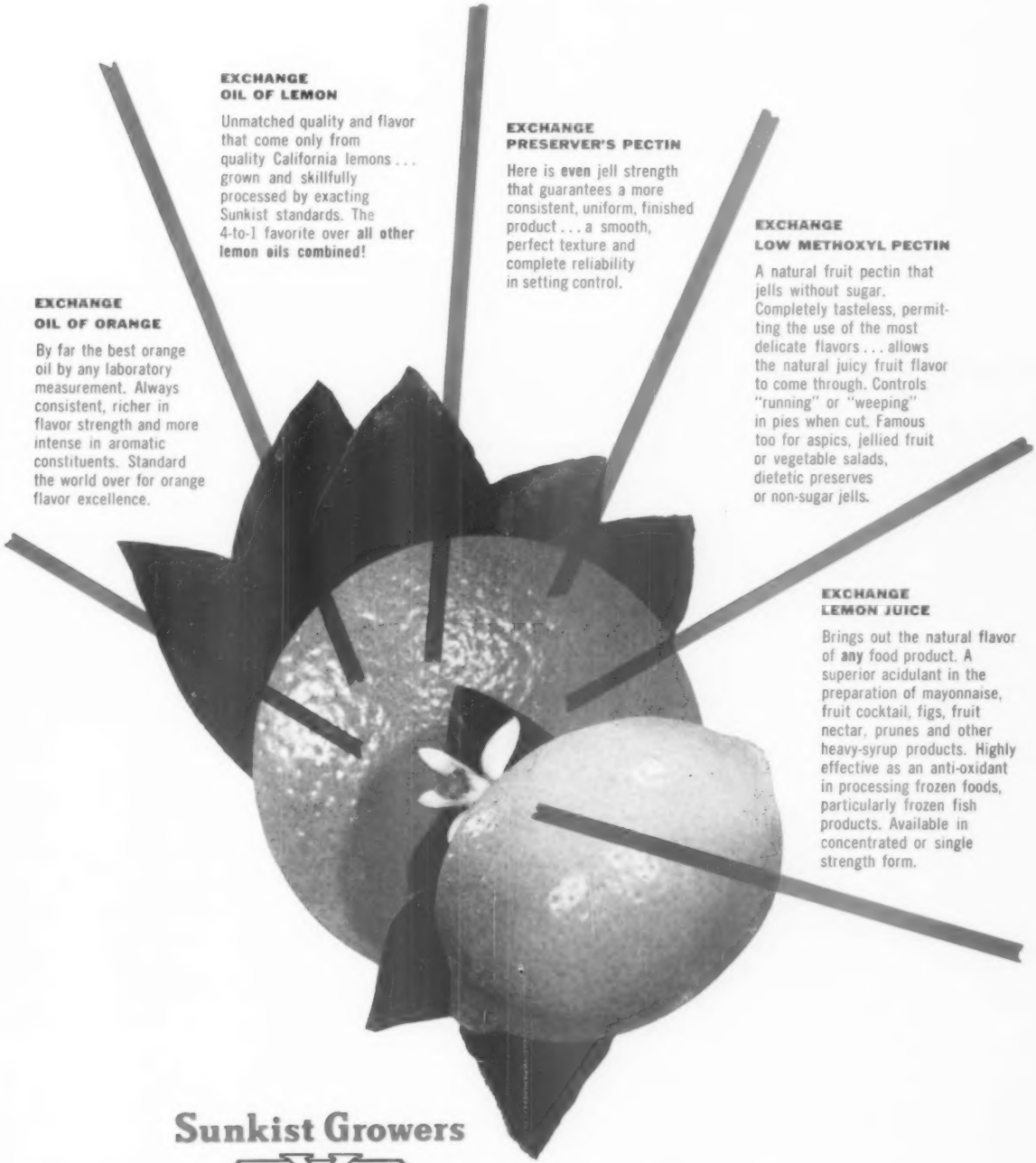

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In Memoriam

Dr. Harold M. Barnett, 52, pioneer in carotene research and production, died February 20 in Long Beach, California, following a heart attack. Dr. Barnett was owner-manager of Barnett Laboratories Inc., producers of carotene for vitamin A enrichment and coloring of margarine, shortening, dairy and bakery foods.

Dr. Barnett was a graduate of Nebraska Wesleyan University and earned his M.S. and Ph.D. degrees in biochemistry at the University of Minnesota. After several years as a research chemist for a large Cleveland corporation, he moved to California where he founded Barnett Laboratories in 1936.

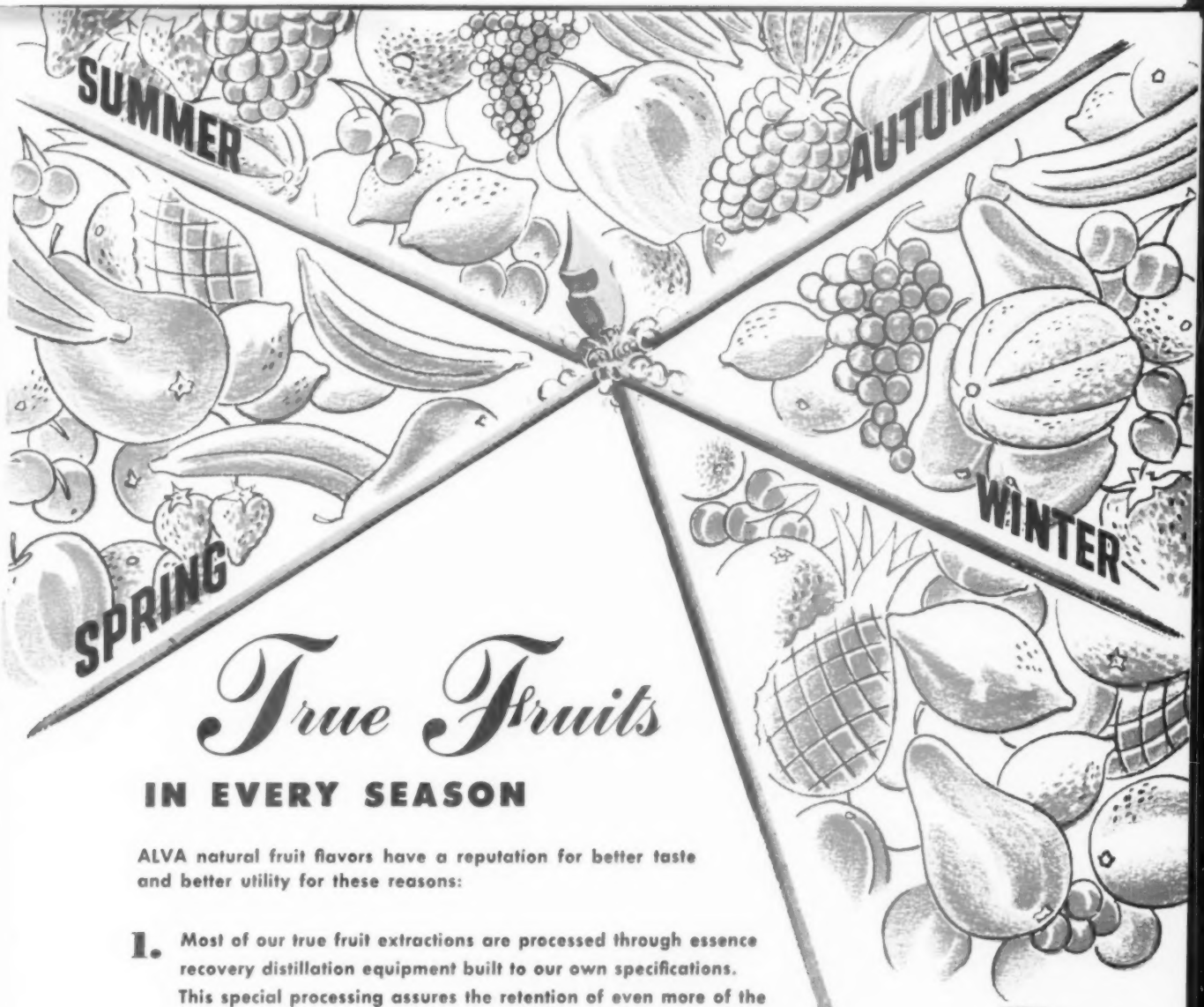
—Contributed by Charles H. Barnett

Mr. James C. Palmer, School of Fisheries, University of Washington and member of the Puget Sound Section of IFT died on January 16, 1956. His many friends in both academic and industry organizations feel very keenly his passing.

On February 20, Dr. John Walter Sale passed away. He was born August 29, 1883. Immediately after his college graduation he entered government service and worked in the Department of Agriculture, Food and Drug Division under Dr. Wiley, the father of the Food and Drug Law. Later on he worked under Dr. Allsberg.

Dr. Sale was very well known in the Food and Drug Administration as he compiled many data for establishing standards of fruits and also in the production of jellies and other products. He made vital contributions in the beverage and food industries and also had several patents which he unselfishly assigned to the United States Government. One of these was production of pure maple concentrate, which he and Mr. Wilson, his associate in the Department, received a patent on. Dr. Sale was very well liked and is well remembered by the Department and by the entire Food Industry.

—Contributed by Alexander Katz



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AWARDS AND HONORS . . .

DR. GAIL M. DACK TO BE HONORED WITH BABCOCK-HART AWARD

Recipient of the Babcock-Hart Award for 1956 is Dr. Gail M. Dack, distinguished bacteriologist, head of the University of Chicago Food Research Institute, and a man of great stature as individual and as citizen. The award will be presented at the Babcock-Hart Award luncheon on Monday, June 11, the second day of the annual meeting of the Institute of Food Technologists convening at St. Louis, June 10-14, 1956.

The Babcock-Hart Award, which honors the famous University of Wisconsin scientists, Stephen M. Babcock and Edwin Bret Hart, is given annually to one "who has advanced human nutrition by outstanding accomplishments in food research and technology." Dr. Dack's attainments in advancing our knowledge of the bacteriology of foods eminently qualify him for the honor to be conferred upon him in June. Through extensive writing, through speeches before scientific groups, in counseling industry and the Military on bacteriological problems he has created for himself a unique place in the scientific and technological world. Profound scientific learning complemented by sound judgment is a quick characterization of the 1956 awardee—readily verified by his contributions to academic, industry, and military interests and activities.

Born in Belvidere, Illinois, on March 4, 1901, Gail M. Dack was raised on a Northern Illinois farm near that town. At the time he enrolled in college he planned to return to farming after finishing his formal education. With this thought in mind he registered in the General Agriculture course at the University of Illinois.

Dr. Gail M. Dack, Babcock-Hart Award Winner, 1956

During his Junior year he enrolled in a course in Dairy Bacteriology taught by Dr. Fred W. Tanner, Head of the Bacteriology Department. This course provided an inspiration which served to shift Dr. Dack's field of interest to Bacteriology and he received his B.S. degree in 1922 from the University of Illinois, with a clear insight into what he wished to do in the world.

Dr. Dack came to the University of Chicago in 1922 and enrolled as a graduate student in the Department of Hygiene and Bacteriology. He distinguished himself early in his graduate work by outstanding basic research studies on *Clostridium botulinum*—studies which merited his selection as the winner of the Howard Taylor Ricketts Award. From 1925 to 1929 Dr. Dack served as an instructor in Hygiene and Bacteriology at the University of Chicago.

In December, 1926, Dr. Dack and his new bride sailed for Europe, using money he had saved while a graduate student. During their European tour they visited hospitals and laboratories, as well as places of historic interest, in Sweden, Denmark, Germany, France, Italy and England. Returning to his studies early in 1927, he continued his advanced work, receiving his Ph.D. from the University of Chicago in 1927.

Dr. Dack served as Assistant Professor (1929-1937) and Associate Professor (1937-1946) in Bacteriology. Since 1946 he has held the rank of Professor of Microbiology.

While an Assistant Professor in Bacteriology, Dr. Dack's scientific interests took their next major turn. He entered the School of Medicine and quickly became an outstanding student in this field also. His election to membership in Alpha Omega Alpha, the honor society for medical students, indicates the kind of scholar he was. He received his M.D. in 1934.

Highlights of his career after medical college. For 8½ years following his medical training Dr. Dack did research on chronic ulcerative colitis in cooperation with doctors both in Surgery and Medicine. The three men with whom he worked most extensively were: Drs. L. R. Dragstedt, T. E. Heinz and J. B. Kirsner.

During World War II Dr. Dack was with the Army and was stationed at Camp Detrick, Maryland. Once again, distinction found him and he was awarded a medal for his outstanding work in the Safety Division at the Biological Warfare Center.

In 1946 Dack became Director of the Food Research Institute of the University of Chicago where investigation of the scientific problems of processing, nutrition, food spoilage, food poisoning, food-borne diseases, and food quality is carried on.

Since becoming interested in food poisoning, he has participated in much human volunteer work in outbreaks involving bacteria of the Staphylococcus, Streptococcus and Salmonella groups. For many years after bacteriology was an established science, "ptomaine poisoning" was the stock explanation given as to why people became ill from food. That the poisoning was due to bacterial toxins seemed evident, but the fact that many of these toxins did not affect the commonly used laboratory animals presented a challenge. Among the scientists who set out to probe this mystery were Dr. Dack, the late Dr. W. E. Cary and their teammates in the University of Chicago's Bacteriology Department. Their experiments could most appropriately be termed —to use a current phrase—"the bold approach." They involved the scientific sampling of two commercially baked Christmas cakes (1929) which had made eleven people ill. The "microbe hunters" dissected the cake and portioned out the parts. One man ate the maraschino cherries, another the top icing, the third the

(Continued on page 30)

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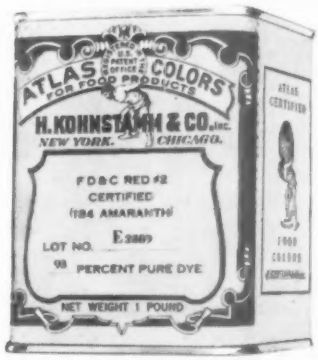

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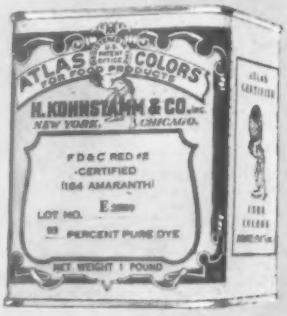

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(Continued from page 28)

cream filling, and the fourth the sponge cake itself. This test showed that the main body of the cake was the toxic portion. To find out if the predominate bacterial flora in the cake was a producer of toxin this organism was isolated and cultured in veal broth. After three days of incubation a filtered broth was made up. Pursuing the problem to its source the three scientists decided to ingest some of the broth. It fell to Dr. Dack's lot to drink the largest of the three portions (25 ml.) of the brew—and he became acutely ill for five hours.. He was hardly in the mood to rejoice over the discovery for three days. With that one sip of toxic broth, however, he had demonstrated conclusively the true cause of "ptomaine poisoning"—a scientific "break through" of the first order for the three microbe hunters.

Dr. Dack's present interest is mainly in the epidemiology of food-borne diseases.

In 1954 Dr. Dack was in Geneva, Switzerland, for a conference as a member of the Expert Advisory Panel on Environmental Sanitation of the World Health Organization.

During Michigan State University's Centennial celebration in 1955, Dr. Dack acquired another honor—the University's Centennial Award for his notable research triumphs in the area of food poisoning.

Dr. Dack has contributed generously of his time and energies to the tasks of professional leadership. He has served as President of the Society of American Bacteriologists and has been active in most of the leading scientific organizations in the fields of bacteriology and medicine. He has long been a member of the National Research Council. In industry councils relating to his interest in food he has also played an important role. During 1955, for example, he was chairman of the Board for the Research and Development Associates, Food and Container Institute, Inc.

The third edition of Dr. Dack's book, *Food Poisoning*, University of Chicago Press, was published early this year. This work reflects the keen insight and the extensive experience of its author. It is a standard treatise on food bacteriology.

Sidelights. Dr. and Mrs. Dack live on a forty-acre farm near Elgin, Illinois. He commutes from there by train to the University of Chicago campus. His daily exercise is provided by walking across Chicago's Loop from the Union Station to the Illinois Central Suburban Station, and then several additional blocks from the suburban train stop to his campus office.

After a busy week Dr. Dack relaxes on weekends by caring for a yard and garden. This arena for home toil is several times as large as would be considered manageable by most of his friends and colleagues. The quality and quantity of fruits and vegetables produced on this plot of ground show the skilled touch of one who hasn't forgotten the farming knowledge acquired first-hand during his boyhood. Probably the most eye-catching part of the yard surrounding the Dacks' home is the extensive lawn. It requires several hours for mowing, even with a garden tractor powered mower. On closer examination during the fruit season the casual observer would be attracted by one apple tree bearing several varieties of apples—evidence again of the born experimenter. Another attraction is the many rows of neatly weeded and cultivated vegetables and berries. These provide the raw materials for the preparation of frozen foods—enough to fill two home freezers in an average year. Dr. Dack is so completely devoted to his gardening enterprise that he doesn't mind being mistaken for the "yard man," an error in identification committed by more than one individual looking for him at his home.

Dr. Dack's other hobbies include painting with water colors and refinishing antique furniture. His status in these fields is not as clear-cut as it is in medicine and bacteriology and awaits evaluation.

Dr. and Mrs. Dack have a son, who lives in Aurora, Illinois, and a daughter living in Indianapolis, Indiana. They have two grandchildren—who are rapidly becoming a major hobby of a devoted grandfather.

It is obvious that Dr. Dack comes from hardy stock. His parents live in Elgin, Illinois, and are still active. Mr. Dack was 89 recently and Mrs. Dack will be 89 soon.

FOOD INDUSTRY TOPICS . . .

. . . by Norb Leinen

. . . in the public interest

The first industry-government commercial evaluation program of an atomic irradiated food product for civilian and military markets is being directed jointly by the Army Quartermaster Corps and AMF Atomics Inc., subsidiary of American Machine & Foundry Co., 261 Madison Ave., New York 16, N. Y., under a joint agreement contract with the QM Food & Container Institute for the Armed Forces, Chicago. Several expert groups, coordinated by AMF Atomics Inc., are evaluating application of gamma radiation upon potatoes—selected because they are important in both civilian and military diets, and because they have shown the most promise in atomic research to date. Seventy thousand pounds of potatoes, comprising a selection of several varieties from both Maine and Idaho, are in storage at Presque Isle, Maine, following irradiation of two-thirds of the lot at the AEC Materials Testing Reactor, Idaho Falls, Idaho. The unirradiated one-third is being used as a control. The program includes six basic studies underway simultaneously at several locations. Included are extensive tests for wholesomeness based on acceptability stand-

(Continued on page 32)

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(Continued from page 30)

ards recently established by Food and Drug Administration and Office of The Surgeon General of the Army. Direction of this phase of the program has been undertaken by the latter. Other studies will investigate radiation effects upon potato nutrient value and physiological changes. Process costs under various shipping, handling, and storage conditions will be examined as part of an economic analysis to determine the impact of the "extended storage life" potato upon present commercial and military markets. A wide variety of cooperating companies representing the potato processing industry will produce and examine quantities of potato chips, frozen French fries, and dehydrated, canned, and pre-peeled products from the irradiated potatoes, in addition to contributing to support of the basic studies.

◆ ◆ ◆

Organizations in the atomic energy field should give as much consideration to public sentiment as to their nuclear products and services, according to Mr. Nicholas Anton, president of Anton Electronic Laboratories, Inc., 1226-38 Flushing Ave., Brooklyn 37, N. Y. He warns that the nuclear industry must act to offset unwarranted rumors and possible nuisance suits that plague those who would set up new atomic facilities. He proposed that industry tell the public what is being done to safeguard health and welfare, with emphasis on the outstanding safety record of both government and industrial atomic energy activities, and outlined a comprehensive program of radiological instrumentation which would meet the most rigid standards of public protection. The program would include a complete survey of the proposed plant or reactor site prior to construction of the facility, and repeated testing after the installation has begun operation.

◆ ◆ ◆

Familiar metal cans will be "unrecognizable" by present standards within a relatively few years, Mr. Wm. C. Stolk, president of American Can Company, said recently. Even can factories may eventually undergo similar striking changes, the Canco executive said. Pointing out that planned obsolescence is "the prime ingredient in our growth and development," he defined it as the process of "improving our business by deliberately making obsolete the things we make or use, our processes and techniques, and our industrial know-how." Research is turning up new materials and production methods that are making possible cans for many products never before packaged in metal containers, he added. "We have gained so much momentum that I don't hesitate to predict that the metal cans of 5 years from now will be unrecognizable by today's standards," he said. "More than that, the cans of tomorrow will be better and more economical, and far more products will be packed in them than ever before." Mr. Stolk also foresaw the possibility that entirely different production methods, such as welding and use of plastic cements and synthetic resin coatings, eventually may reduce the amount of machinery and the size of can factories as much as one-half, with an accompanying increase in productivity.

◆ ◆ ◆

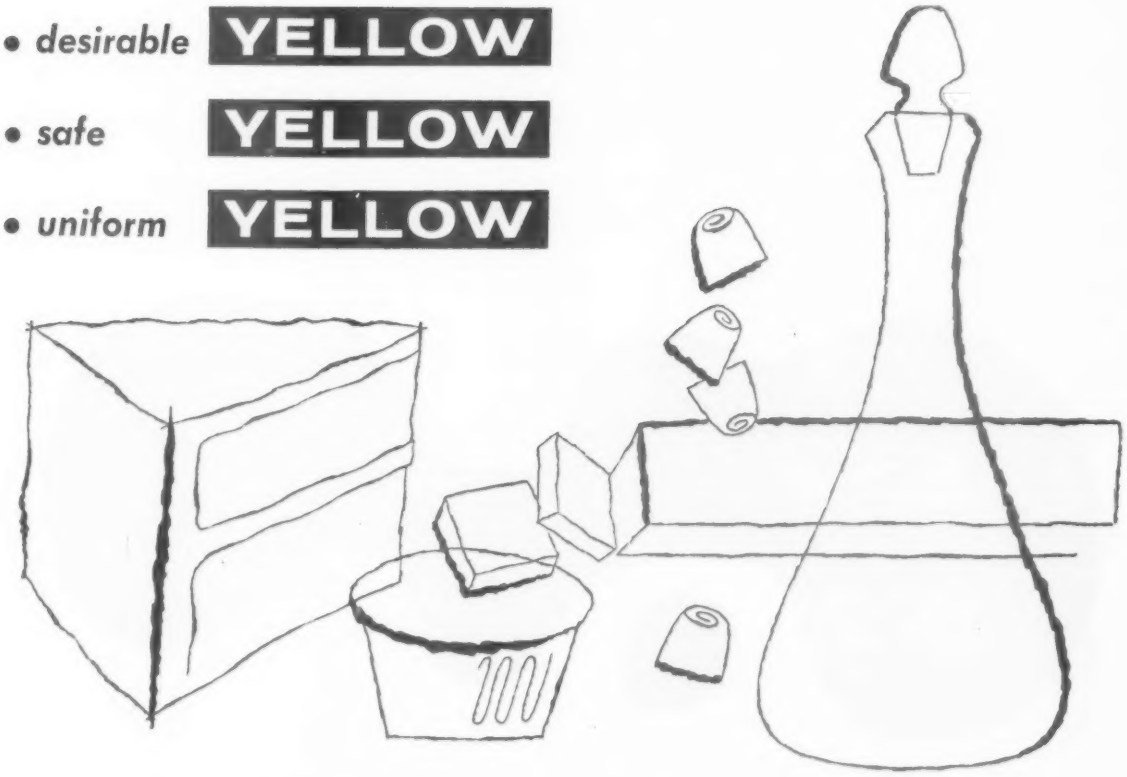
Bacon in rolls rather than stuck together in strips? Eggs repackaged in synthetic shells rather than the impractical protection furnished by the hen? Freewheeling into the future at the recent Alcoa Wrap press conference in New York City, Mr. J. G. Balmer, vice president, Harley Earl, Inc., Detroit, said the problem of prying bacon strips apart can be solved by packaging the product in its own aluminum frying pan or in roll form on foil with a kind of Scotch Tape-like dispenser. With regard to eggs, he expects to see them in synthetic shells before long. Such "eggs," he states, will be easier to open and will contain preservatives to keep them fresh longer. Tomorrow's electronic kitchen presents even more interesting packaging developments. Mr. Balmer suggests that in the electronic cooking of new prepackaged food forms we may season foods right through the package with a hypodermic needle. Open the package when the food is hot and ready to serve. Flour may come from a sifting package or maybe by the cup. Big cereal and detergent boxes may become compressible packages so that when half empty they won't take as much room. "In all this packaging development," he said, "we hope you'll see meltable bottles and jars and crushable cans which will simplify disposal without adding expensive appliances to the kitchen." Harley Earl, Inc., consultants to Alcoa's own designing and research development group, designed the Alcoa Wrap package and the Alcoa label.

◆ ◆ ◆

Basing his comments on a recently completed GMA study, Mr. Paul S. Willis, president of Grocery Manufacturers of America, Inc., 205 E. 42nd St., New York 17, N. Y., analyzed some major charges made about "price spread"—the difference between what the farmer gets and what the consumer pays for food products at the retail grocery. Regarding statements that the price spread is too wide, he said, "Higher wages, higher taxes, and higher transportation costs have accounted for about 80% of the increase in spread since 1939. "Concerning charges that the drop in farm prices has not been reflected in retail food prices due to profiteering and inefficiency on the part of "middlemen," Mr. Willis said, "Since 1952—peak year of retail food prices—two-thirds of the drop in raw farm food prices has been passed along to consumers in lower retail prices. During this time, the average combined rate of net profits of grocery manufacturers and distributors has remained the same. There has been no increase. Meanwhile, greater efficiencies in food processing and distribution have helped cushion increases in wages and other costs." On the charge of profiteering, he said combined net profits of grocery manufacturers and distributors today are at the rate of about 3c of the consumer's food dollar as compared with nearly 6c in 1939. Instead of adding to the postwar increases in price spread, the industry's lower rate of profit has offset to some

(Continued on page 34)

- *desirable* **YELLOW**
- *safe* **YELLOW**
- *uniform* **YELLOW**



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(Continued from page 32)

extent the increase of other costs. Regarding the charge that the rise in spread is chiefly responsible for the decline in net farm income, Mr. Willis said, "Spread has caused the decline in net farm income, but it is not the spread we have been talking about—namely, between farm prices and retail food prices. The spread between gross income and net income is of crucial importance. It has been widening because of the continuing increase in farm production expenses for labor, transportation, taxes, machinery, and other factors—cost increases similar to those experienced by food manufacturers and distributors."

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Public confidence, which controls spending the half of U.S. income going into what used to be considered luxuries, is the governing factor in maintaining high-level industrial activity, according to Mr. Crawford H. Greenewalt, president of the Du Pont Company. Calling for a temperate attitude on the part of all important segments of the nation, including business, labor, government, the consumer, and each individual, Mr. Greenewalt said, "I feel sure we are becoming . . . a nation of conservatives in the sense that more and more people have moved into an economic status where they have something to conserve. Our average American today, as he accustoms himself to his new situation, should become increasingly distrustful of measures which could upset this situation . . . In thinking about the economic road ahead, it is important for us to remember that we live not in an economy of need, but in an economy of abundance . . . About half of our expendable income now is devoted to providing necessities. The rest of it goes into what used to be considered luxuries. Expenditures for this sort of thing are deferable. We do not actually need to have them today or tomorrow. This simply means that collective confidence is the principal criterion affecting the state of business at any particular time," he concluded.

◆ ◆ ◆

American medical education is the finest in the world, but only public interest and support can keep it that way, according to Mr. Geo. H. Coppers, president, National Biscuit Co., and chairman of the Food Division of the Committee of American Industry which is spearheading an appeal of the National Fund for Medical Education for an annual $10 million to keep the nation's 81 medical schools in business. Mr. Coppers urged men and women in the food industry to get behind the nation's first Medical Education Week, April 22-28, "by informing themselves of the job the medical schools are doing." Medical Education Week is sponsored jointly by the National Fund for Medical Education, the Association of American Medical Colleges, and the American Medical Association and its allied groups.

◆ ◆ ◆

The Polyethylene Extrusion Coaters Group (a division of Specialty Paper and Board Affiliates) has developed 5 new commercial standards for its members and for users of poly-coated materials. Among tentative new standards established by the Group's Standards Committee is the weight of polyethylene per ream for 1 mil thickness—14.4 pounds of polyethylene to be equivalent to one mil. This standard has been adopted by all members of the Extrusion Group in the interest of product uniformity. Other standards concerning terminology, product quality, and testing procedures are in the formative stage. Inquiries from concerns interested in activities of the Polyethylene Coaters, particularly from those interested in membership, are invited by Mr. G. D. Cook, secretary of the Specialty Paper and Board Affiliates, 122 E. 42nd St., New York, N.Y.

. . . *things new under the sun*

An entirely new loaf of light bread containing a **new concentrate of complete protein** called "V-10 Protein"—offering a remarkable high complete protein value with extremely low fat content—was introduced recently by Wisconsin Alumni Research Foundation (WARF), Madison, Wis. No exclusive marketing arrangements are being made, and the development is available to all bakers, regardless of size or location. The Protein Concentrate is being manufactured by Special Foods Co., Red Wing, Minn. A full-scale merchandising job is being carried out in test markets by King Midas Flour Mills—licensed to supply high protein bread mix to bakeries.

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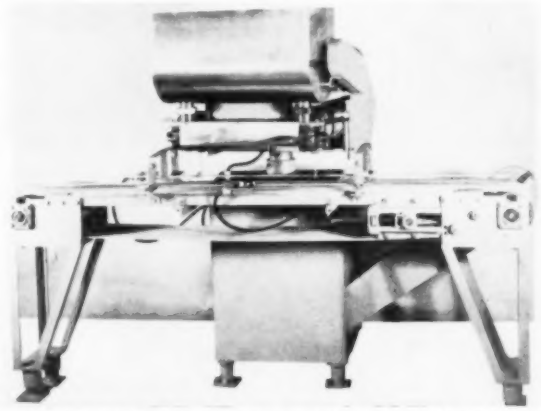

The Pfaudler Twin, a two-station straight line piston filler, has been brought out by The Pfaudler Company to meet requirements of smaller canners. Outstanding feature is ease of dismantling and speed of cleaning. No change in parts are necessary for changes in height or diameter of container. Multiple sizes of cans, jars, and cartons, ranging from 4 ounces up to full gallons are easily handled. Speeds range from 25 to 50 containers per minute, depending on container size. Manually operated, the machine will fill pails. Among products handled are jams, jellies, marmalades, soups, tomato paste, heavy purees, baker's jellies, fresh strawberries, cream, corn, baby foods, and other semi-liquids. The machine is self-contained with a motor, drive, and conveyor. An agitator for the filler bowl to maintain uniformity of product is available. There are no additional motors to buy. Write the firm c/o L. M. Harvey & Co., Skyline Bldg., Syracuse 3, N. Y.

◆ ◆ ◆

A new product offered to margarine manufacturers by Barnett Laboratories, 6256 Cherry Ave., Long Beach 5, Calif., is their highest quality **natural caro-**

(Continued on page 52 following technical papers)

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SELECTED ABSTRACTS . . .

Compiled by H. A. Campbell

ANALYTICAL METHODS

Use of microorganisms as analytical tools.

HARRIS, D. A. (Merck & Co., Inc., Rahway, N. J.). *Anal. Chem., 27,* 1690-4 (1955).

Microorganisms can be used successfully to assay various antibiotics, vitamins, and amino acids with an acceptable degree of accuracy even when crude and unknown types of materials are involved. In general, they are inexpensive to run, not difficult to handle, and can be adapted for large-scale operations. In many cases they represent the only satisfactory analytical tool available for use in specific chemical, stability, biological standardization, nutritional, and microbiological studies.

BIOLOGICAL SCIENCES

BIOCHEMISTRY

The combined amino acids in several species of marine algae.

SMITH, D. G., AND YOUNG, E. G. (Maritime Regional Lab., Nat. Res. Council, Halifax, N. S.). *J. Biol. Chem., 217,* 845-53 (1955).

The distribution of the combined amino acids in whole plants of 5 species of marine algae was detd. by quant. chromatography after extn. with 75 per cent ethanol. The compn. of amino acids in the brown algae, *Ascophyllum nodosum* and *Fucus vesiculosus* was very similar. The distribution in the red alga, *Rhodymenia palmata,* and the green alga, *Ulva lactuca,* was also similar, but differed markedly from that in the brown algae. *Chondrus crispus* was distinctive for its high content of arginine and for the presence of ornithine and citrulline in the acid hydrolyzate of the insoluble material of the dried plant.

Effect of amino acid and vitamin B_{12} supplements on the biologic value of proteins in rice and wheat.

SURE, B. (Dept. of Agr. Chem., Univ. Ark., Fayetteville). *J. Am. Dietet. Assoc., 31,* 1232-4 (1955).

The proteins of milled and processed milled rice were improved by the addn. of lysine, threonine, and methionine and the proteins in enriched milled hard wheat flour were improved by addns. of lysine, threonine, valine, and vitamin B_{12}. Vitamin B_{12} in addn. to stimulating greater food intake also produces greater efficiency of protein utilization.

Interfacial pressure of proteins.

HAUROWITZ, F., BAUCHER, P., DICKS, M., AND THERRIAULT, D. (Dept. Chem., Indiana Univ., Bloomington). *Arch. Biochem. Biophys., 59,* 52-9 (1955).

The interfacial tension between *p*-xylene and neutral or alk. buffer solns. is lowered by bovine serum albumin, bovine serum γ-globulin, fibrinogen, pepsin, gelatin, and oxyhemoglobin from 37 to values ranging from 15 to 24 dynes/cm. Salmine does not lower the interfacial tension at *p*H 6 or 8. The structure of protein films in the water/*p*-xylene interface is discussed.

The effect of liquid ammonia on proteins. I. Insulin.

ELLENBOGEN, E. (Dept. Biochem. & Nutr., Univ. Pittsburgh, Pa.). *J. Am. Chem. Soc., 77,* 6634-5 (1955).

Long exposure of insulin to liquid NH_3 did not alter any of its phys. and chem. properties as judged by soly., sedimentation constant, crystallizability, biol. activity, ratio of max./min. absorptivities in the ultraviolet, infrared absorption spectra and total N content. It was observed that 60 mols. of H_2O per mol. of insulin were so tightly bound that they did not react with the NH_3, indicating that H_2O mols. play an important part in the stabilization of protein structure.

Hydrolysis of amylose by β-amylase and Z-enzyme.

NEUFELD, E. F., AND HASSID, W. Z. (Dept. Plant Biochem., Coll. Agr., Univ. Calif., Berkeley). *Arch. Biochem. and Biophys., 59,* 405-19 (1955).

The fact that potato amylose is incompletely hydrolyzed with pure β-amylase unless another factor (Z-enzyme) is added was confirmed. Treatment with hot alkali of the resistant limit dextrin has an effect similar to treatment with Z-enzyme in that it causes the residual dextrin to be further hydrolyzed with β-amylase. The exact degree of β-amylolysis depends on the plant material from which the sample of amylose is derived, the subfraction used, or on the previous treatment of the amylose sample.

Specificity in chemical and enzymatic oxidations of glucose anomers.

BENTLEY, R. (Grad. Sch. Public Health, Univ. Pittsburgh, Pa.). *Nature, 176,* 870-3 (1955).

The observed differences in the rates of oxidation of the glucose anomers are believed to be explained on the basis that: (a) the reaction mechanism necessitates a rate-detg. attack on a hydroxyl group; and (b) that in α-D-glucose the axial hydroxyl is sterically hindered. Similar principles will be helpful in many other branches of carbohydrate chemistry and in the interpretation of some aspects of enzyme specificity. It is significant that an enzyme (mutarotase) which catalyzes the interconversion of α- and β-glucose has recently been described in some notatin prepns. and in animal issues.

Synthesis of sucrose and other β-d-fructofuranosyl aldosides by levansucrase.

HESTRIN, S., FEINGOLD, D. S., AND AVIGAD, G. (Dept. of Biochem., Hebrew Univ., Hadassah Med. Sch., Jerusalem, Israel). *J. Am. Chem. Soc., 77,* 6710 (1955).

D-Xylose, L-arabinose, D-glucose, D-galactose, and melibiose were shown to be converted to corresponding aldosyl-β-D-fructofuranosides on reaction with raffinose or sucrose in the presence of levansucrase. The findings indicate that levansucrase catalyzes the establishment of an equilibrium of the following form: raffinose + glucose ⇌ sucrose + melibiose.

The inhibiting effect of folic acid on the oxidation of ascorbic acid.

GERO, E., AND LEMOIGNE, M. M. *Compt. rend., 239,* 1879-81 (1954); *Z. Lebensm. Untersuch. u-Forsch., 102,* 363 (1955).

Folic acid has a substantial stabilizing effect on ascorbic acid solns. provided they are protected from light (*p*H 7). Pteridin and *p*-aminobenzoic acid radicals are suspected to be responsible for this phenomenon.

MICROBIOLOGY

On the sources of carbon for the induced biosynthesis of alpha-amylase in Pseudomonas saccharophila.

MARKOVITZ, A., AND KLEIN, H. P. (Dept. of Microbiol., Med. Sch., Univ. of Wash., Seattle). *J. Bacteriol., 70,* 649-55 (1955).

In a growing cell expt., using isotopically labeled cells, it was shown that a small but significant portion of the α-amylase was synthesized from pre-existing C compds. of the cell. With C^{14}-labeled cells it was shown that in resting cells about 65% of the C for the induced biosynthesis of α-amylase comes from C compds. of the cell. Using C^{14}-labeled starch it was shown that, in resting cells, approx. 39% of the enzyme C comes from the substrate. Free amino acids and a peptide were demonstrated in exts. of *Pseudomonas saccharophila.*

Some aspects of the induced biosynthesis of alpha-amylase of Pseudomonas saccharophila.

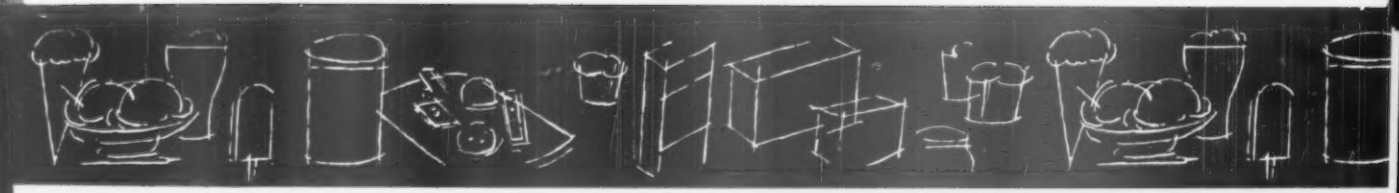
MARKOVITZ, A., AND KLEIN, H. P. (Dept. Microbiol., Med. Sch., Univ. Wash., Seattle). *J. Bacteriol., 70,* 641-8 (1955).

An extracellular α-amylase was shown to be formed in resting cellular suspensions of *Pseudomonas saccharophila,* using maltose or starch as inducers. The kinetics of α-amylase appearance were shown to be linear. Both substrates are essentially equivalent on a wt. basis, and the level of enzyme produced is proportional to substrate concn. The synthesis of α-amylase is stimulated by the addn. of acid-hydrolyzed casein or NH_4Cl only in the presence of inorganic salts essential for growth.

Survival of bacteria upon repeated freezing and thawing.

HARRISON, A. P. (Dept. Biol., Van-

(Continued on page 38)



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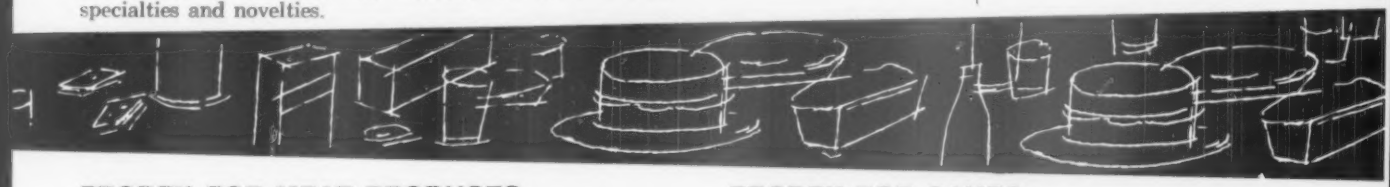

FRODEX FOR MEAT PRODUCTS

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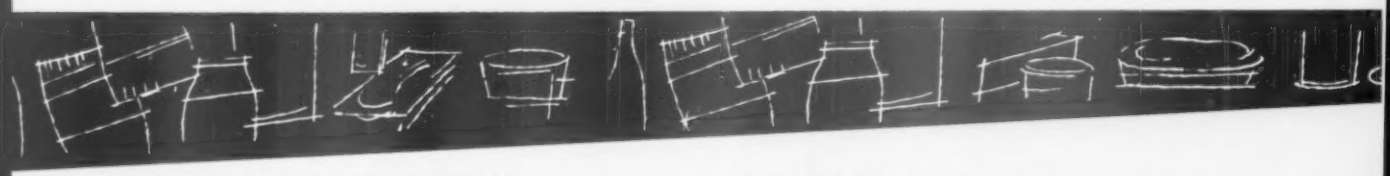
Frodex minimizes loss of color during processing and storage. It is an excellent moisture conditioner for longer shelf life, promotes better texture, less shrinkage and minimum watering-off. Frodex is a better binding agent for better appearance, stabilizes the fat-content of meat products as an emulsifying agent.

FRODEX FOR CAKES

Frodex helps increase volume, produces a finer grain and smoother texture, helps maintain oven freshness for longer shelf life, enhances flavor through its mellowing effect, produces a richer golden brown crust color and lowers production costs with increased yield.



FRODEX FOR DRY FOOD MIXES

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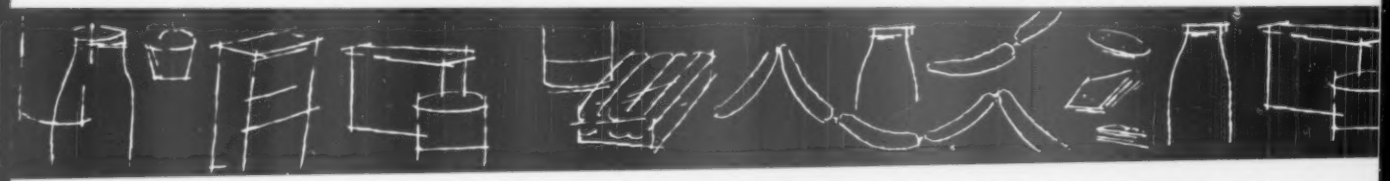
Frodex enhances natural color, retards oxidation, particularly in the neck of the bottle, and does not mask the true condiment flavors of the catsup.



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(Continued from page 36)

derbilt Univ., Nashville, Tenn.). *J. Bacteriol., 70,* 711-15 (1955).

Although *Lactobacillus fermenti* upon a single freezing-thawing manifests a survival which is constant and independent of the initial cell concn., the percentage survival which results after a series of repeated freezing and thawing varies in proportion to the initial cell concn. At moderately high cell concns., survival of *E. coli* to successive freezings is, at first, greater in H_2O than in broth, but after additional successive freezings the coverse may be true. Aerated cells of *E. coli*, whether suspended in H_2O or both, at first survive much better than nonaerated cells, but upon additional freezings the difference becomes less pronounced.

The fermentation of pectin and pectic acid by Bacillus polymyxa.

Potter, L. F., and McCoy, E. (Dept. Bacteriol., Univ. of Wis., Madison). *J. Bacteriol., 70,* 656-62 (1955).

It was possible to obtain good fermentation of pectin with *Bacillus polymyxa* strain 30 if yeast ext. was used as a source of growth factors. With this medium good fermentation was obtained in shake flasks, but not in deep culture. Daily transfers in low pectin medium, the addn. of buffer to the medium and the addn. of glucose to the medium did not improve pectin fermentation. Slow feeding of pectin during the fermentation increased the amt. of pectin fermented but not the rate of fermentation. Analysis of the pectin fermentation of *B. polymyxa* in shake flasks and deep culture showed that 50% of a 2% pectin suspension was fermented in 120 hours. By comparison the pectic acid fermentation was very rapid in shake flasks (over 80% was fermented in 12 hours), but deep culture fermentation was slower (only 75% was fermented in 48 hrs.). In both fermentations galacturonic acid decreased, showing that it was fermented further.

Symposium on microbiology of the rumen.

Hungate, R. E. (Wash. State Coll., Pullman). *Bacteriol. Revs., 19,* 277-9 (1955).

The importance of microorganisms to the ruminant has interested an increasing number of nutritionists, particularly those in departments of animal science. In view of this interest of agricultural workers, it is surprising to find relatively few rumen microbiologists. Formal discussions on this subject have been held in England and France but the Rumen Microbiology Symposium at the Fifty-fifth General Meeting of the Society of American Bacteriologists was the first in the United States. It was arranged to present and compare different points of view rather than to summarize current knowledge. A more extensive meeting, including participation by microbiologists from many countries, would be necessary for an adequate treatment of all phases of the subject.

NUTRITION

The amino acid requirements of man. XIII. The sparing effect of cystine on the methionine requirement.

Rose, W. C., and Wixom, R. L. (Div. Biochem., Univ. Ill.). *J. Biol. Chem., 216,* 763-73 (1955).

Experiments were conducted in normal young men to ascertain the sparing effect of L-cystine upon their minimal methionine needs. The methionine requirement of each subject was first established in the absence of dietary L-cystine. An excess of the latter amino acid was then incorporated in the food and the methionine requirement again detd. The results demonstrate that L-cystine is capable of replacing 80 to 89 percent of the minimal methionine needs of adult man, as measured by the maintenance of *N* equil. Attention is called to the significance of this finding, particularly in those areas of the world in which methionine appears to be the limiting amino acid in the native diets.

The amino acid requirements of man. XV. The valine requirement; summary and final observations.

Rose, W. C., Wixom, R. L., Lockhart, H. B., and Lambert, G. F. (Div. Biochem., Univ. Ill.). *J. Biol. Chem., 217,* 987-95 (1955).

In accordance with the practice followed with other essential amino acids, the highest observed value, or 0.8 gm. of L-valine, is proposed tentatively as the minimal daily requirement of man. In formulating diets designed to exclude amino acid deficiencies, allowance should be made for the possibility that individuals other than those tested may have still higher needs. For this purpose, twice the highest observed value, or 1.6 gm. of L-valine daily, is certainly a safe intake.

The amino acid requirements of man. XVI. The role of the nitrogen intake.

Rose, W. C., and Wixom, R. L. (Div. of Biochem., Univ. Ill.). *J. Biol. Chem., 217,* 997-1004 (1955).

A diet contg. the 8 essential amino acids in quantity sufficient to permit adequate synthesis of the non-essential amino acids, suitably supplemented with extra N, in the form of glycine, to provide a total daily intake of 3.50 gm., is sufficient to maintain N equil. On the assumption that 0.35 gm. of unknown N, in the form of contaminants of the starch and other dietary constituents, is utilizable, one may calculate that the minimal nitrogenous needs of man for the synthesis of the non-essential amino acids cannot exceed 2.55 gm. daily, and probably is significantly less than this quantity.

The intakes of essential amino acids of children who were deriving most of their protein from bread and vegetables.

Hughes, B. P. (Dept. of Expt. Med., Cambridge Univ.). *British J. Nutr., 9,* 373-7 (1955).

The essential amino acid intake of children in 2 German orphanages who received diets consisting largely of bread and vegetables was calcd. and compared with the intake of British children. The German children received 51 to 73 g. of protein per day of which 11 to 18% was of animal origin. In contrast, the British children consumed 65 g. of protein per day of which 65% was of animal origin. Since the German children grew rapidly and were in good health, their amino acid requirements must presumably have been met by chiefly plant protein foods.

Leucine-isoleucine antagonism.

Harper, A. E., Benton, D. A., and Elvehjem, C. A. *Arch. Biochem. Biophys., 57,* 1 (1955).

Feeding high levels of leucine to rats under certain conditions retarded growth but supplementation of diet with isoleucine relieved the growth inhibition. Results of these expts. suggest that leucine may act as an isoleucine antagonist and inhibit its utilization for protein synthesis.

Sugar in pig starters.

Lewis, C. J., Catron, D. V., Combs, G. E., Ashton, G. C., and Culbertson, C. C. (Iowa Agr. Expt. Sta., Ames). *J. Animal Sci., 14,* 1103-15 (1955).

Three expts. involving 328 baby pigs were conducted to study the influence of cane sugar in pig starter diets. In all preference studies, where 2 or more starters were offered simultaneously, the baby pigs selected starters contg. sugar. Pellets contg. 20% sugar inside were preferred to sugar-coated pellets. Feed efficiency of sugar-fed pigs was significantly improved.

The digestion of acetylated monoglycerides and of triglycerides.

Herting, D. C., Ames, S. R., Koukides, M., and Harris, P. L. (Res. Labs., Div., Eastman Kodak Co., Rochester). *J. Nutrition, 57,* 369-87 (1955).

The mode of digestion of cottonseed oil lard, hydrogenated lard, and distilled acetylated glycerides was studied by analyzing the lipid recovered from the stomach, small intestine, cecum-colon, and feces after feeding diets contg. the various fats to adult rats. The digestion of cottonseed oil and lard had little lipolysis occurring in the stomach, but extensive lipolysis occurred in the small intestine, with the resulting products being absorbed rapidly. A large amt. of fecal lipid was found, in the digestion of a characteristic satd. triglyceride, fully hydrogenated lard. The digestion of the distd. acetylated satd. monoglycerides coincided with that of hydrogenated lard. The digestion of distilled, acetylated, mixed satd. and unsatd. monoglycerides prepd. from lard was intermediate between those for the satd. and unsatd. triglycerides. The absorption of the digestive products of the distilled acetylated monoglycerides depended largely on their fatty acid compn.

(Continued on page 40)

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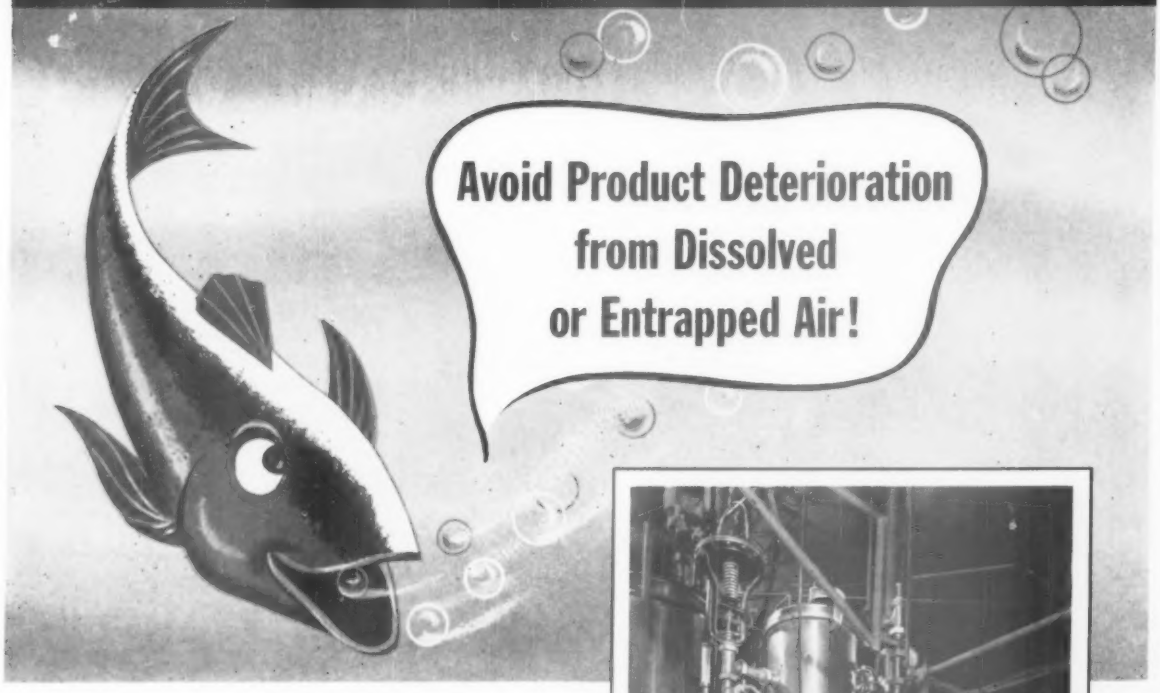

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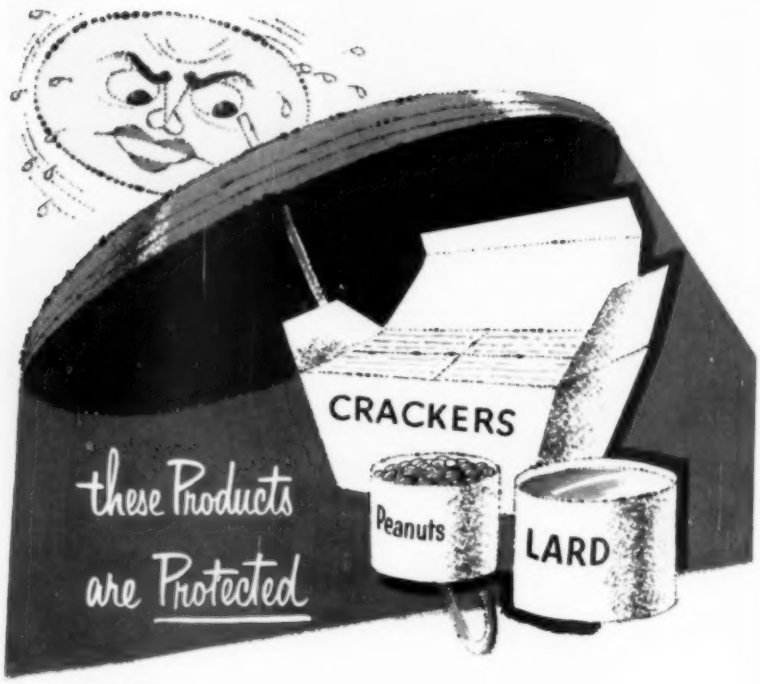

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(Continued from page 38)

Studies on the nutritive values of lipids. IX. Nutritive value of polymerized liver oil of dog fish.

KANEDA, T., AND ARAI, K. *Bull. Japan. Soc. Sci. Fisheries, 19* (5): 700-2 (1953); *Biol. Abstr., 29*, 28356 (1955).

Some shark liver oils can be refined into edible oil. However, all the liver oils have a fishy odor which can be deodorized by polymerization. The polymerized oils thus obtained are steam distilled in vacuum. Rats were fed fat free basal diets contg. original liver oil of dog fish, its polymerized oil, deodorized oil and soybean oil as a control. Nutritive value of the original liver oil was slightly lower than that of soybean oil. However, the polymerized oil and its deodorized product proved more nutritious than that of the other oils.

The effects of liver disease on certain aspects of tocopherol metabolism in man.

KLATSKIN, G. (Yale Univ. Sch. Med., New Haven). *Ann. New York Acad. Sci., 57* (6): 909-18 (1954).

Previous reports of low plasma tocopherol levels in liver disease were confirmed. However, these low levels may not result from impaired absorption, but from an increased rate of tocopherol breakdown in the intestinal tract. Dietary deficiency can be a contributory factor.

Nitrogen, calcium, and phosphorus utilization by 12- to 14-year-old boys.

DAUM, K., TUTTLE, W. W., GUGEDAHL, A., ROBERTS, H., AND SALZANO, J. (Depts. Nutr. Physiol., State Univ. Iowa). *J. Am. Dietet. Assoc., 32*, 36-8 (1956).

The N, Ca, and P retentions of six boys varying from 12 to 14 years were detd. during three different breakfast regimens, at intervals, during a six months period. Mean N, Ca, and P retentions were positive during all breakfast regimens which were: a basic cereal and milk breakfast, "no breakfast," and a basic bacon-egg-and milk breakfast. There was no significant difference in N retention between the basic cereal-and-milk and basic bacon-egg-and-milk breakfast.

Ability of sodium sulfate to stimulate growth of the chicken.

SIZER, I. W. (Mass. Inst. of Technol., Cambridge, Mass.). *Science, 122*, 1270-1 (1955).

Dietary sulfate stimulated normal feather development in chickens, even though the S amino acid content was too low to support optimum growth. Inorganic sulfate cannot replace dietary cystine or methionine for protein synthesis, and studies with $Na_2S^{35}O_4$ confirmed these results, although sulfate apparently will "spare" dietary S amino acids for protein synthesis.

Food practices of older people living at home.

LYONS, J. S., AND TRULSON, M. F. (Dept. Nutr., Harvard Sch. Public Health). *J.Gerontol., 11*, 66-72 (1956).

A survey of 100 men and women 65 years of age and over showed that approx. one-fourth of the people were consuming

(Continued on page 44 following technical papers)

Gas Production and Yeast Roll Quality After Freezer Storage of Fermented and Unfermented Doughs*

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Agricultural Experiment Station and College of Home Economics, University of Tennessee, Knoxville

(Manuscript received August 1, 1955)

The quality of yeast breads obtained from frozen doughs varies considerably according to reports from several laboratories *(2, 3, 4, 5, 6, 10)*. Conditions that assure high quality have not been clearly established, although some improvements have been obtained by changes in formulae or fermentation procedures.

McPherson and Lamb *(6)* found that a 50% increase in sugar and a 50% decrease in yeast in a standard bread formula afforded some improvement in the quality of white bread made from frozen dough. Zaehringer, Mayfield and Odland *(10)* reported that active dry yeast was more satisfactory than compressed yeast for frozen doughs up to 4 weeks, producing loaves of significantly better volume. However, both groups reported that breads from frozen doughs were of inferior quality because of coarse grain and compactness.

Fenton *(4)* and McPherson and Lamb *(6)* obtained improved quality in breads when the dough was not fermented before freezing. Godkin and Cathcart *(5)* reported that unfermented doughs had better proofing properties after freezing than fermented doughs.

Studies of yeast survival in doughs as measured directly by plate counts, or indirectly by gas production before and after freezer storage, have not shown a definite relationship between yeast activity and bread quality. Charles and Van Duyne *(3)* reported that the number of viable yeast cells in shaped fermented doughs was not significantly reduced until after 9 weeks of freezer storage, but the quality of rolls obtained from the corresponding doughs was lowered at all storage periods, and the gas production was significantly decreased after the first week. Godkin and Cathcart *(5)* observed normal plate counts for 1 to 3 weeks but that yeast cells in fermented dough tended to die off at a faster rate than in unfermented dough. Since plate counts did not always support baking tests, they suggested that yeast cells may lose reproductive ability but retain fermentative activity during freezer storage.

There have been several recommendations that yeast doughs be shaped after freezer storage *(6, 8, 9)*. Preliminary observations in this laboratory *(7)* have also indicated that yeast doughs shaped after freezer storage produced rolls superior in quality to those shaped before freezing. The present study was an attempt to determine the effects of freezing on gas production in fermented and unfermented yeast doughs, and the effects of manipulating doughs after freezing on roll quality.

PROCEDURE

Four series of yeast rolls were tested after 2, 4, 8 and 12 weeks of freezer storage in the dough state. The effect of freezing on gas production in fermented and unfermented doughs was measured. The role of manipulation was studied by shaping part of the rolls before storage and part after storage. To distinguish between the changes in gas production and changes due to manipulation, some of the rolls frozen preshaped were reshaped before the pan-proof period.

Preparation of doughs. A sweet dough formula was developed which produced high scoring rolls from freshly prepared doughs. The formula and details of procedure follow:

Ingredients	Weight in grams	Percentage based on flour	Method of mixing
Milk	457	35.8	Scald milk (85° C.), add sugar, salt, and fat. Cool to 37° C. Add egg and cool to 30° C.
Sugar	188	14.7	
Salt	30	2.3	
Fat, hydrogenated cottonseed oil	156	12.2	
Egg	120	9.4	
Yeast, active dry	28	2.2	Boil water, cool to 30° C. and weigh. Add yeast and dissolve. Let stand 10 minutes. Add to milk mixture.
Water	245	19.2	
Flour, all purpose	1278	100.0	Add 550 g. flour to milk-yeast mixture. Using beater, mix 1 min. (speed 1). Scrape down bowl, mix 30 sec. (speed 2). Add remaining flour, stir 12 strokes by hand. Using dough hook, knead 5 min. (speed 1) scraping bowl and turning dough at end of each minute.

Doughs were mixed in a Model N-50 KitchenAid electric mixer by the straight dough method. All mixing was done in an air conditioned room maintained at 22° C. and approximately 65% relative humidity. Sufficient dough was mixed at one time to provide for tests before freezing and for 2 storage periods selected at random. The temperature of the dough was 28° to 29° C. at the end of mixing.

Treatment of the fresh doughs. Immediately after mixing, each batch of dough was weighed into 2 equal parts. One part was prepared for freezing without fermentation (hereafter designated as unfermented dough). The other portion was fermented 90 minutes before freezing[b] (hereafter designated as fermented dough). Half of each lot of fermented and unfermented dough was shaped into 40-g. rolls before freezing; the remainder was frozen unshaped, as bulk dough.

Packaging and freezing doughs. Shaped doughs were frozen in muffin tins for about 5 hours before packaging. Bulk doughs were packaged before freezing. Both shaped and unshaped doughs were packaged in polyethylene bags and placed in locker cartons. Eight 40-g. portions of shaped dough or 200 g. of bulk dough were put in each package. All products were frozen in a home freezer at approximately —30° C. and transferred to a freezer locker for storage at —18° C.

Thawing, proofing, and baking. Data on thawing and proofing doughs are shown in Table 1. Both shaped and unshaped doughs were thawed at 30° C. to an internal temperature of 25° C. The unshaped doughs were then weighed, shaped, and placed in pans for proofing. Half of the preshaped rolls were reshaped by folding the dough 10 times before placing in pans

* Published with the approval of the Vice-Director, Tennessee Agricultural Experiment Station.

[b] A thermostatically controlled incubator was used for fermentation and pan-proofing. The temperature was 30° C. ± 0.5° and the relative humidity, 67% ± 4%.

TABLE 1

Preparation data on fresh and frozen fermented and unfermented yeast roll dough

Fresh fermented dough		Doughs frozen unfermented								
Pan-proof time	Total time from mixer to oven	Freezer storage time	Time required to thaw to 25° C.		Time required to pan-proof to a height of 47 mm.			Total time from freezer to oven		
			Shaped	Unshaped	Shaped	Reshaped	Unshaped	Shaped	Reshaped	Unshaped
min.	*min.*	*weeks*	*min.*	*min.*	*min.*	*min.*	*min.*	*min.*	*min.*	*min.*
124	133	2	44	103	137	131	111	185	179	217
125	134	4	53	109	132	136	115	189	195	228
122	134	8	46	108	149	143	121	201	194	232
116	127	12	46	107	153	135	121	201	184	232
Fresh fermented dough		Doughs fermented 90 minutes before freezing								
88	189	2	48	103	99	107	95	151	158	202
88	191	4	58	107	100	110	101	161	172	213
86	191	8	47	104	126	130	120	180	182	228
80	179	12	47	105	143	139	135	192	188	246

for proofing. The remaining thawed, preshaped rolls were pan-proofed without additional manipulation. Rolls from both fresh and stored doughs were pan-proofed to a height of 47 mm.

Testing Roll Doughs and Baked Rolls

Gas production in fresh and stored doughs. Gas production before and after freezer storage was determined in duplicate on 20-g. samples of dough by a modification of the A.A.C.C. pressuremeter method *(1)*. Pressuremeters were held in a water bath maintained at 30.5° C. ± 0.1°. Gas production was measured over a 3-hour period following the conventional 5-minute warm-up period.

In measuring gas production before freezer storage, the unfermented dough was sampled at the end of mixing when it was being packaged for freezer storage. The fermented dough was sampled at the end of the fermentation period when this portion was being packaged for freezing. Proofing of the doughs for fresh rolls was started at the same time. To measure gas production after freezer storage, samples were taken from both shaped and unshaped doughs after they had thawed to 25° C., the beginning of the pan-proof period.

Testing rolls. Volume and quality measurements were made on rolls baked from freshly prepared doughs and on those baked after freezer storage of the dough. Volume of the baked rolls was determined by seed displacement, 1 to 2 hours after the rolls had cooled to room temperature. The quality of the rolls was graded subjectively by 3 experienced judges. A 100-point scoring system was used: shape, 10; volume, 15; crust, 10; color of crumb, 5; grain, 15; texture, 15; odor, 10; taste, 20.

RESULTS

Changes in gas production. The average values for gas production are shown in Table 2. All doughs were reduced in gas production after freezer storage, except the unfermented bulk dough during the first 4 weeks. Beyond 4 weeks of freezer storage, fermented doughs tended to decrease at a faster rate than unfermented doughs. However, the actual amount of gas produced in the fermented doughs exceeded that produced in the unfermented doughs during the first 8 weeks of freezer storage. After 8 and 12 weeks of freezer storage, gas production was significantly reduced in all except the unfermented bulk dough. Doughs frozen preshaped did not differ significantly in gas production from doughs frozen in bulk quantity (Table 5).

Changes in roll volumes. Average values for roll volumes are shown in Table 3. Rolls made from freshly prepared fermented dough were larger than rolls from fresh unfermented dough. After freezer storage, differences in roll volume were associated more with shaping, than with fermentation (Table 5). Whether prepared from fermented or unfermented dough, all rolls frozen preshaped were significantly smaller than rolls from the same dough, shaped or reshaped after freezing. Rolls from unfermented dough when shaped or reshaped after freezing were 4 to 8% larger than rolls from the corresponding freshly prepared dough, and approximately the same volume as rolls from fermented dough with the same treatments. Through 8 weeks of freezer storage, rolls from fermented dough when shaped or reshaped after freezing were approximately the same volume as rolls from fresh fermented dough.

Changes in roll quality. Average values for quality scores are shown in Table 4. As was expected, rolls from fresh fermented dough were superior to rolls from fresh unfermented dough. They were larger and finer grained, had thinner cell walls, better spring and better flavor. After freezer storage, differences between rolls from fermented and unfermented doughs of similar shaping treatment were not as marked. At all test periods, preshaped rolls from either fermented or unfermented doughs were significantly inferior to rolls shaped or reshaped after freezer storage (Table 5). They were also inferior to rolls from the corresponding fresh doughs. However, there was some difference in the performance of fermented and unfermented doughs after freezing.

When unfermented dough was frozen unshaped, the rolls were of better quality than fresh rolls through 4 weeks of freezer storage and equivalent in quality to fresh rolls through 12 weeks of storage. Rolls which were reshaped after freezing were equivalent to fresh rolls through 12 weeks of storage. When fermented dough was shaped or reshaped after 2 and 4 weeks of freezer storage the quality of the rolls was not significantly different from that of rolls from fresh fermented dough. Beyond

TABLE 2

Gas production in unfermented and fermented yeast roll doughs after freezer storage

Freezer storage time	Unfermented dough [1]				Fermented dough [2]			
	Preshaped		Bulk		Preshaped		Bulk	
	Pressure	Frozen/fresh	Pressure	Frozen/fresh	Pressure	Frozen/fresh	Pressure	Frozen/fresh
weeks	*mm. Hg.*	*%*	*mm. Hg.*	*%*	*mm. Hg.*	*%*	*mm. Hg.*	*%*
2	262	95.6	285	104.0	330	94.3	332	94.9
4	259	94.5	280	102.2	323	92.3	325	92.9
8	241	88.0	258	94.2	295	84.3	277	79.1
12	250	91.2	263	96.0	271	77.4	235	67.1

[1] Values for fresh unfermented doughs averaged 274 mm. Hg. }
[2] Values for fresh fermented doughs averaged 350 mm. Hg. } L. S. D. = 26.5 at 5% level; 35.5 at 1% level.

TABLE 3

Volume of rolls from unfermented and fermented yeast doughs after freezer storage

Freezer storage time	Unfermented dough [1]						Fermented dough [2]					
	Shaped before freezing		Reshaped after freezer storage		Shaped after freezer storage		Shaped before freezing		Reshaped after freezer storage		Shaped after freezer storage	
	Volume	Frozen/fresh	Volume	Frozen/fresh	Volume	Frozen/fresh	Volume	Frozen/fresh	Volume	Frozen/fresh	Volume	Frozen/fresh
weeks	*ml.*	*%*	*ml.*	*%*	*ml.*	*%*	*ml.*	*%*	*ml.*	*%*	*ml.*	*%*
2	158	98.8	173	108.1	171	106.9	165	91.7	181	100.6	179	99.4
4	156	97.5	169	105.6	173	108.1	158	87.8	173	96.1	179	99.4
8	156	97.5	169	105.6	169	105.6	156	86.7	177	98.3	177	98.3
12	150	93.8	169	105.6	167	104.4	144	80.0	169	93.4	165	91.7

[1] Volume of fresh rolls from unfermented doughs averaged 160 ml. } L. S. D. = 9.2 at 5% level; 12.2 at 1% level.
[2] Volume of fresh rolls from fermented doughs averaged 180 ml. }

TABLE 4

Quality scores of rolls from fresh and frozen unfermented and fermented yeast doughs

Type of dough	Treatment	Freezer storage time in weeks	Qualities scored [1]								Total score (100) (L.S.D. = 3.1 at 5% level, 4.2 at 1% level)
			Shape (10)	Volume (15)	Crust (10)	Color of crumb (5)	Grain (15)	Texture (15)	Taste (20)	Odor (10)	
Unfermented dough	Fresh	None	10	12	9	5	11	12	17	9	85 ± 2.4
	Shaped before freezing	2	9	11	9	5	10	11	16	9	80 ± 1.3
		4	9	11	9	5	10	11	17	9	81 ± 1.9
		8	9	11	8	5	9	9	16	8	74 ± 1.6
		12	9	10	9	5	10	9	15	8	75 ± 1.5
	Reshaped after freezer storage	2	9	13	9	5	12	12	17	9	86 ± 2.0
		4	10	13	9	5	12	12	17	9	87 ± 2.2
		8	10	13	9	5	11	11	17	9	84 ± 1.4
		12	9	13	9	5	11	11	16	9	82 ± 1.5
	Shaped after freezer storage	2	10	13	9	5	13	13	17	9	90 ± 1.6
		4	9	13	9	5	13	13	18	9	91 ± 3.1
		8	9	13	9	5	12	12	17	9	87 ± 1.3
		12	9	13	9	5	12	12	17	9	86 ± 1.2
Fermented dough	Fresh	None	10	14	10	5	14	14	19	10	94 ± 1.4
	Shaped before freezing	2	9	12	7	4	9	11	16	9	78 ± 3.4
		4	9	12	6	4	8	11	16	9	75 ± 1.2
		8	9	11	6	4	9	10	15	8	71 ± 5.2
		12	9	9	6	3	7	9	13	7	63 ± 1.7
	Reshaped after freezer storage	2	10	15	10	5	13	14	17	9	92 ± 2.7
		4	10	14	10	5	13	13	18	9	91 ± 2.2
		8	10	14	9	4	9	11	16	8	82 ± 3.5
		12	9	13	8	4	7	10	15	8	73 ± 1.5
	Shaped after freezer storage	2	10	14	10	5	13	14	18	10	94 ± 1.3
		4	9	14	10	5	13	14	18	9	93 ± 2.8
		8	10	14	10	5	13	13	17	9	90 ± 1.7
		12	10	12	9	5	12	12	16	8	85 ± 1.7

[1] Maximum score in parentheses.

TABLE 5

Analysis of variance in gas production, roll volumes, and roll quality

Source of variation	Gas production			Volume			Quality		
	Degrees of freedom	Mean square	F value	Degrees of freedom	Mean square	F value	Degrees of freedom	Mean square	F value
Total	79			111			111		
Fresh fermented vs. fresh unfermented	1	22763.3	131.58**	1	1567.2	33.70**	1	397.06	119.50**
Within fresh	14	173.0		14	46.5		14	3.32	
Fresh vs. frozen	1	12757.6	36.50**	1	173.8	4.48*	1	735.3	151.30**
Frozen fermented vs. frozen unfermented	1	21443.9	61.36**	1	319.2	8.24**	1	60.77	12.50**
Shapings	1	190.7	<1.00	2	3056.0	78.84**	2	1815.32	373.52**
Fermented × shaping	1	3683.1	10.53**	2	58.7	1.51	2	124.22	25.56**
Storage time	3	8544.0	24.44**	3	494.6	12.76**	3	472.22	97.16**
Fermented × storage	3	3279.5	9.38**	3	122.3	3.16	3	107.19	22.06**
Shaping × storage	3	544.4	1.56	6	43.1	1.11	6	12.92	2.66*
Fermented × shaping × storage	3	220.3	<1.00	6	6.5	<1.00	6	15.55	3.20**
Pooled error	48	349.5		72	38.8		72	4.86	

*Significant at 5% level.
**Significant at 1% level.

4 weeks of freezer storage, the quality was inferior to that of rolls from fresh fermented dough and approximately equivalent to quality of rolls from unfermented dough which had been shaped after freezing.

The greatest decrease in quality occurred in rolls from fermented dough shaped before freezing. After 12 weeks of storage, the average score had dropped to 63. These preshaped rolls from fermented dough were reduced in volume, had blistery crusts which browned excessively, coarse grain with compact layers and harsh, dry texture with reduced spring.

DISCUSSION

Data from the variance analyses, Table 5, indicate that the stage at which the dough was shaped was the most important factor affecting the quality of the rolls. High quality was associated with manipulation of the dough after freezing. It was observed that frozen doughs were friable and felt lifeless upon thawing. By manipulating the doughs either to shape or reshape the rolls, they seemed to regain the normal, elastic feel of freshly mixed dough with resultant improvement in roll quality. The manner in which manipulation afforded this improvement can only be conjectured. It is possible that freezing damaged the gluten framework in the dough and that this damage was counteracted by remanipulating the thawed dough. Both fermented and unfermented doughs produced rolls of acceptable quality through 12 weeks of freezer storage when frozen in a bulk quantity and shaped after thawing even though the gas produced in the fermented dough was significantly reduced beyond 4 weeks of freezer storage. The poor quality of rolls obtained from the preshaped doughs after all periods of freezer storage agrees with the findings of several others *(2, 3, 4, 5, 6, 10)* The improvement in quality when the doughs were shaped after freezing agrees with previous work in the authors' laboratory *(7)*.

When the ability of the dough to maintain gas production after freezing is considered in relation to the quality of rolls obtained with different shaping treatments, the preferred method of handling yeast doughs would seem to be: to freeze without fermentation and to shape or reshape after thawing. Since considerable time is required to thaw bulk dough, it may be more convenient to shape dough before freezing and reshape before pan-proofing after thawing.

SUMMARY

Rolls were prepared from fermented and unfermented yeast doughs after 2, 4, 8 and 12 weeks of freezer storage. Doughs were stored as shaped rolls and bulk dough to investigate the effects of manipulation after freezing on roll quality. Gas production in fresh and stored doughs was determined by pressuremeter.

Manipulation of the doughs after freezing was found to be the most important factor affecting the quality of rolls obtained from frozen doughs. Doughs frozen in a bulk quantity for as long as 12 weeks yielded acceptable quality rolls. Inferior quality rolls were obtained at each test period from doughs shaped before freezing.

Gas production was decreased significantly in both fermented and unfermented doughs after 4 weeks of freezer storage. However, reduction in roll quality was associated more with shaping treatments than with decrease in gas production.

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The Effect of Assignment of Testing Materials to the Paired and Odd Position in the Duo-Trio Taste Difference Test*

John W. Mitchell

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(Manuscript received October 29, 1955)

To achieve best results, that is, the greatest number of correct responses, the assignment of materials in a duo-trio test is a factor of great concern. It is shown that in testing for flavor intensity, use of the weaker material as paired samples improves discrimination. In testing for an atypical flavor, use of the typical flavor as paired samples produces more correct responses than does the reverse.

The assignment of test materials to the paired and to the odd position in a duo-trio taste difference test or in a triangular test has been the subject of some speculation. Pfaffman *(3)* and coworkers found that holding the assignment constant gave better discrimination. Peryam and Shapiro *(2)* and many others have indicated the use of a fixed standard as the paired samples. On the other hand, Byer and Abrams *(1)* used random assignment in their comparison of the triangle and two sample methods.

There are logical arguments for holding the odd sample constant, most of which center on the theme of identification. There can be little doubt that the subject in a taste difference test will on occasion find some distinctive property by which he can identify one or both test materials. If he knows that this identified material will continue to appear as either the paired or the odd sample in later replications, his succeeding judgments are reduced to identification. In repeated duo-trio tests (where one of the paired samples is always given first, followed by the remaining paired sample and the odd sample in unknown random order), after one or two tests, some subjects will refuse the first of the paired samples yet will be able to identify the odd sample. Certainly, the assumption that such identification is used in all studies has face validity even though when samples are nearly alike identification may be on an unconscious level.

However, observations on studies of somewhat unusual research samples have led to the belief that holding the odd sample constant for all tests does not always lead to the most sensitive result. On several occasions the duo-trio was run using one material as the paired sample on half of the test and the second half was run using the same material as the odd sample. It was found that significantly more correct responses occurred with one arrangement than with the other. These observations led to the formulation of two hypotheses:

I. If the primary difference between two materials is one of flavor intensity, the subject in a duo-trio test will respond correctly more often if the first sample he receives (the identified member of the pair) has the weaker flavor.

II. If one of the two materials has an unusual or atypical flavor, the subject in a duo-trio test will respond correctly more often when that material is the odd sample.

The first hypothesis is based on the theory from psychophysics that a neurological trace from the first stimulus may make the second seem greater than it actually is. It follows then that if the weaker flavored material is used as the odd sample it will seem stronger than normal because of the trace from the preceding, stronger flavored sample. Therefore, it will appear closer to the intensity of the strong sample and be harder to detect. If the weaker flavored material is used for the paired samples, hence is tasted first, the stronger, odd sample will seem even stronger because of the added trace and be more easily distinguished.

The second hypothesis is based on the observation that an unusual flavor once taken into the mouth may persist for a certain time. If this unusually flavored material is the odd sample, and is tasted after the normally flavored first member of the pair, the difference will be readily apparent. If it is used for the paired sample and therefore tasted first, the normally flavored, odd sample may seem to have a similar flavor through carry-over and be hard to distinguish.

EXPERIMENTAL

Materials. The materials for this study were prepared in two groups. The first group was used to test the intensity hypothesis. The more intense material was normal blended whiskey. The less intense material was the same blended whiskey with varying amounts of grain neutral spirits added. In the second group, one of the two materials was also normal blended whiskey. The other material was the same whiskey to which varying quantities of different highly flavored grain spirits were added to produce an atypical flavor.

Methods. The duo-trio method was used in which the subject receives in sequence first, one of the paired samples identified as such, and following this in random order, the odd sample and the second member of the pair. He is instructed to select the sample which is different from the first of the paired samples, i.e. the odd sample. Conditions such as the temperature, color, concentration, and quantity of the samples, time interval between tests, and rinsing were rigidly controlled.

Each subject made two judgments at a sitting and 10 subjects were used in each test. The materials in each of the two groups were tested in two ways, once with each of the two materials used as the paired samples. All tests in the study of the unusually flavored samples were replicated. The results were recorded as the number of correct judgments out of twenty.

* The experimental work for this paper was done while the author was employed by Joseph E. Seagram and Sons, Inc., Louisville, Kentucky.

Subjects. Ten subjects were used for these tests. All were thoroughly trained in the duo-trio method having participated in such tests daily for several years.

RESULTS AND DISCUSSION

The results are presented in Tables 1 and 2. The data in Table 1 show appreciably more correct responses when the stronger flavored material was used as the odd sample. Table 2 shows more correct responses when the unusually flavored material was used as the odd sample. The χ^2 test proves both results to be highly significant.

TABLE 1
Number correct in duo-trio tests of materials differing only in flavor intensity

Percent neutral spirits added to less intense material	Number of correct responses in twenty judgments	
	More intense material as paired samples	More intense material as odd sample
%		
10	11	11
15	10	10
20	10	16*
25	12	14
30	10	13
40	10	13
50	10	13
60	10	12
70	10	15*
80	12	14
90	13	16*
100	13	16*
110	10	15*
120	10	17*
130	12	20*
Total, all samples	163	215
Excess of correct responses over chance expectancy	13	65

χ^2 (excess correct responses) $= \frac{(13-39)^2+(65-39)^2}{39} = 34.7.$

Significant .01.

*Test result that would reject the null hypothesis at the 5% level.

If one considers a probability of .05 or less as indicating a significant difference, on the first series (Table 1) there were 7 instances of significant discrimination with the stronger material as the odd sample and none when it was used for the paired samples. In the second series (Table 2) with added flavored spirits, there was one instance of significant discrimination with the normally flavored material as the odd sample and ten when it was used as the paired samples.

TABLE 2
Number correct in duo-trio tests of material representing normal vs. atypical flavors

Sample number of atypically flavored whiskey	Number of correct responses in twenty judgments			
	Normal flavored whiskey as paired samples		Normal flavored whiskey as odd sample	
	First replication	Second replication	First replication	Second replication
1	12	11	10	10
2	20*	20*	12	15*
3	18*	20*	11	14
4	20*	20*	10	12
5	18*	20*	10	11
6	18*	18*	10	12
Total, all samples	106	110	63	74
Total, both replications	216		137	
Excess of correct responses over chance expectancy	96		17	

χ^2 (excess correct responses) $= \frac{(96-56.5)^2+(17-56.5)^2}{56.5} = 55.2.$

Significant .01.

* Test result that would reject the null hypothesis at the 5% level.

The evidence is conclusive that the choice of material for the paired and the odd samples in a duo-trio test may have an important effect on the result of that test. The data support the hypothesis that this will occur if the difference between the test materials is one of flavor intensity, in which case it is easier to identify the stronger flavored material when it is used as the odd sample. Similarly it seems to be easier to detect an unusually flavored material if it is the odd sample.

These conclusions, though based on significant data, are in themselves sterile. The implication is that prior knowledge of the type of variation occurring in the materials to be tested will serve as a guide in setting up the study. However this knowledge is generally not available. The same prior knowledge is implied by those people who suggest a 2-sample test in place of a triangular or duo-trio test. Such a recommendation is sound only when the fact and the dimension of difference is known. In actual practice one usually knows little or nothing about the dimension of difference, or even whether a difference exists. Certainly, it is a waste of testing time to study samples which are known to be different just to create data to show that difference.

Because of this lack of prior knowledge a procedure was developed as an integral part of the difference test itself to indicate which arrangement, i.e. to use a given material as the paired or the odd sample, if either, was more sensitive. The first 5 subjects are tested using one assignment of materials. If 8 or more of their 10 responses are correct, indicating reasonably good discrimination, the next 5 subjects test using the same arrangement and the final result is calculated on the basis of these 20 responses. If less than 8 of the first 10 responses are correct, the assignment of materials is reversed for the second group of 5 subjects. If there are less than 8 correct on this second set of responses, it is assumed that neither assignment of materials gives an advantage and the test is stopped at that point. However, if there are 8 or more correct with this reversed assignment, a third group of 10 judgments is obtained using the second assignment of materials and the test result is determined by the last 20 judgments.

As can be seen, in some cases the method requires an increase in the number of responses obtained, and the system is somewhat arbitrary. Nevertheless, in routine testing it has continued to give highly reproducible data and it is would seem to be sufficient justification for its use. A similar procedure could be worked out using other groupings of subjects or numbers of responses. The important point is that both possible assignments of material are tried; if one is more sensitive, full advantage is taken of this increased sensitivity. It is only through such a method that the findings in this experiment can take on real meaning for practical testing.

SUMMARY

Two hypotheses were tested: 1. If the primary difference between two test materials is one of flavor intensity, there will be a higher proportion of correct re-

sponses if the weaker material is used for the paired samples. II. If one of the two materials has an unusual or atypical flavor, there will be a higher proportion of correct responses when that material is the odd sample.

A series of paired materials (whiskeys) was prepared for the test of each hypothesis and both possible assignments of these materials to the paired and odd samples in a duo-trio test were used. In one series the only difference between the two materials was flavor intensity. The data indicated significantly better discrimination when the stronger flavored material was used as the odd sample. The main difference in the second series was that one material had a normal whiskey flavor while the flavor of the other was atypical. Significantly better discrimination resulted when the normally flavored whiskey was used for the paired samples.

Based on these results, a refinement of the duo-trio test was suggested which determines and takes advantage of the more sensitive assignment of materials.

Acknowledgment

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Objective Evaluation of the Maturity Factor in Processed Sweet Corn[a,b]

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A trimetric test for the objective evaluation of the maturity factor in canned and frozen sweet corn is presented. The data show that the trimetric test, consisting of percentage of alcohol insoluble solids, percentage of pericarp, and kernel size, may be used with considerable reliability to evaluate the tenderness-maturity of processed whole kernel corn.

The United States Standards for Grades of Canned Whole Kernel Corn *(9)* and for Frozen Whole Kernel Corn *(10)* recognize that tenderness-maturity is the outstanding factor of quality. In these two standards 40 and 50 points respectively are assigned to this quality factor. Considering the fact that other factors of quality, such as flavor and color, are also associated with maturity it may be stated that the grade for processed whole kernel sweet corn rests largely on the evaluation of the tenderness-maturity factor.

It is therefore desirable for the buyer as well as the processor and inspector of sweet corn to have available a reliable objective method for the evaluation of tenderness-maturity. Although the grade is evaluated by subjective methods, a more accurate evaluation may be accomplished by suitable objective methods. In seeking a suitable objective method this cooperative work was undertaken.

The work on processed sweet corn has been applied primarily to the canned product *(7)*, relatively little study being made of frozen sweet corn *(2)*. Of the many methods proposed for the processed product, the measurement of solids insoluble in alcohol (A.I.S.) appeared to be the most satisfactory. However, even this method did not appear to be sufficiently accurate under all conditions of varietal, climatic, and geographic variations to justify its use in place of subjective evaluations with respect to qualities of canned whole kernel corn above U. S. Grade C quality. Previous work at the University of Maryland *(4)* on the development of objective methods for measuring raw corn for processing indicated that moisture, pericarp, and kernel size of the corn are important factors that greatly influence the tenderness and maturity of sweet corn. For these reasons a trimetric test based on these three factors was undertaken on canned and frozen whole kernel corn. As the moisture content of processed sweet corn might be influenced by variations in processing procedures, the moisture part of the trimetric test was replaced with the determination of alcohol-insoluble solids, which is closely related to total solids, and which has been shown to be in itself one of the best measures of quality of processed sweet corn.

MATERIALS AND METHODS

During the 1953 growing season, 10 varieties of sweet corn, considered to be most suitable for processing, were grown at the Salisbury farm of the Maryland Agricultural Experiment Station. On the basis of careful pre-testing with the trimetric method, each of these varieties were harvested 4 times, at 4 stages of maturity, in order to provide samples that were expected to grade high *fancy*, low *fancy*, *extra standard*, and *standard* quality after processing (Table 1). Immediately following each harvest for each variety, each lot was husked, trimmed, and cut, the kernels again were tested by the trimetric

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method, and the remaining material was processed as canned and frozen whole kernel corn in accordance with common commercial practice, at the nearby plant of John H. Dulany and Son. In this way 40 experimental samples each of canned and frozen sweet corn of known history were prepared.

In addition, 53 canned and 32 frozen samples of commercially packed sweet corn were collected by members of the Agricultural Marketing Service from processors in Maryland, Maine, Pennsylvania, Illinois, Indiana, Michigan, Wisconsin, Iowa, Minnesota, Colorado, Utah, Idaho, and Washington.

All of the 93 samples of canned and 72 samples of frozen corn were brought to the laboratories of the Fruit and Vegetable Division, Agricultural Marketing Service, Washington, D. C., where the following analyses were made:

A. Subjective tenderness-maturity scores by 3 members of the Agricultural Marketing Service, in accordance with the official procedures *(9, 10)*.

B. Panel scores as provided by a group of 6 judges (for the frozen samples) and 10 judges (for the canned samples), drawn from among sweet corn packers, U. S. Department of Agriculture personnel, and University of Maryland personnel. Each judge was required to score the maturity of each sample subjectively on a 10-point scale, where a score of 10 was equivalent to top fancy maturity, and a score of 1 was substandard.

C. Objective determinations: The percentage of alcohol-insoluble solids (A. I. S.) was determined in accordance with the Food and Drug method *(8)*. The pericarp determinations were made, using the method described by Kramer, Guyer, and Ide *(6)* with a modification described by Barton *(1)*. The method is as follows:

1. Blend 100 g. of kernels with about 200 ml. of water in a Waring blender for 5 minutes.

2. Wash the macerate through a 30-mesh screen, using liberal quantities of water, until all of the comminuted material has gone through the screen and only the shredded pericarp remains on the screen.

3. Dry the screen and pericarp at 100° C. for 2 hours and weigh.

4. Flame the screen until the organic material has been destroyed, cool, and weigh.

5. The weight of the screen plus dry sample, minus the weight of the flamed screen, equals percent pericarp.

The kernel size was determined by the method described by Kramer *(4)* where 20 kernels are lined up side by side and the combined widest diameters are recorded in inches.

The data were analyzed statistically to determine the correlations between the various tests and nomographs were then constructed from the multiple regression equations by which the

TABLE 1

Comparison of actual and predicted tenderness-maturity evaluation scores of experimental samples of canned and frozen whole kernel sweet corn harvested in August by method of scoring and by variety [1]

Variety	Score of samples						Harvested [2] in August
	Canned			Frozen			
	USDA	Trimetric		USDA	Trimetric		
		Actual	Predicted		Actual	Predicted	
Golden Crown	37-F	38-F	38-F	46-F	47-F	48-F	11
Golden Crown	35-x	35-x	35-x			46-F	12
Golden Crown	32-x	32-x	32-x	41-x	44-x	43-x	17
Golden Crown	30-s	32-x	30-s	36-s	41-x	38-s	20
Seneca Chief	37-F	39-F	38-F	47-F	49-F	48-F	10
Seneca Chief	37-F	37-F	36-F			47-F	11
Seneca Chief	36-F	36-F	34-x			45-F	14
Seneca Chief	34-x	33-x	32-x	42-x	44-x	42-x	18
Golden x Bantam	39-F	40-F	39-F	49-F	49-F	49-F	7
Golden x Bantam	37-F	39-F	37-F			48-F	10
Golden x Bantam	33-x	33-x	33-x	48-F	44-x	44-x	14
Golden x Bantam	30-s	31-s	31-s	37-s	41-x	41-x	18
Victory Golden	38-F	40-F	40-F	49-F	50-F	50-F	10
Victory Golden	37-F	37-F	36-F	49-F	48-F	47-F	13
Victory Golden	35-x	34-x	34-x	46-F	45-F	45-F	17
Victory Golden	32-x	33-x	32-x	45-x	44-x	42-x	20
Hoosier Gold	39-F	40-F	40-F			50-F	6
Hoosier Gold	39-F	39-F	38-F	48-F	48-F	48-F	7
Hoosier Gold	35-x	36-F	34-x	45-F	45-F	45-F	10
Hoosier Gold	33-x	33-x	32-x	45-F	43-x	41-x	14
Sweetangold	39-F	40-F	40-F	49-F	49-F	50-F	11
Sweetangold	38-F	36-F	36-F	48-F	48-F	47-F	13
Sweetangold	33-x	33-x	33-x	44-x	43-x	44-x	17
Sweetangold	31-s	31-s	31-s	40-s	41-x	41-x	20
Tendermost	38-F	40-F	39-F	49-F	48-F	49-F	11
Tendermost	38-F	38-F	36-F			47-F	12
Tendermost	36-F	34-x	33-x	44-x	43-x	45-F	17
Tendermost	35-x	34-x	32-x	43-x	43-x	42-x	20
Iochief	38-F	39-F	39-F	49-F	47-F	49-F	10
Iochief	37-F	35-x	36-F	46-F	44-x	47-F	12
Iochief	35-x	33-x	33-x	43-x	45-F	44-x	17
Iochief	30-s	32-x	31-s	40-s	43-x	40-s	20
Double Duty	39-F	39-F	38-F	48-F	49-F	48-F	12
Double Duty	38-F	36-F	36-F	48-F	46-F	47-F	13
Double Duty	35-x	34-x	34-x	45-F	44-x	45-F	17
Double Duty	32-x	32-x	30-s	42-x	41-x	38-s	20
Prosperity	39-F	40-F	39-F	48-F	48-F	49-F	11
Prosperity	38-F	38-F	36-F	48-F	47-F	47-F	13
Prosperity	35-x	34-x	34-x	45-F	42-x	45-F	17
Prosperity	32-x	32-x	31-s	42-x	42-x	41-x	20

[1] F—U. S. Grade A or U. S. Fancy. x—U. S. Grade B or U. S. Extra Standard. s—U. S. Grade C or U. S. Standard.
[2] Planted June 1, 1953.

grade scores for maturity could be determined from objective test data.

RESULTS AND DISCUSSION

Correlation analyses. The critical test for the suitability of any objective test is its degree of agreement with human evaluation, as obtained by the use of sensory testing panels *(5)*. The degree of agreement may ordinarily be evaluated statistically by the use of the coefficients of correlation and determination. These coefficients between panel scores and the various grading methods are presented in Table 2.

TABLE 2

Coefficients of correlation and determination resulting from averages of panel scores and averages of various methods of evaluating tenderness-maturity of experimental samples of canned and frozen whole kernel corn

Method of scoring	Coefficients of—			
	Correlation		Determination[1]	
	(Canned (r)	Frozen (r)	Canned	Frozen
			Percent	*Percent*
USDA	0.929	0.926	86.3	85.7
Trimetric				
Raw	0.928	0.900	86.1	81.0
Canned	0.968		93.7	
Frozen		0.910		82.8
A. I. S.				
Canned	0.916		83.9	
Frozen		0.878		77.0

[1] Obtained by multiplying r^2 by 100.

The coefficients of correlation between average panel scores and average USDA scores of 0.929 and 0.926, respectively, for the canned and frozen samples indicate an excellent degree of agreement between these two essentially subjctive evaluations. This may be taken to mean that the group of 3 official inspectors evaluated these samples in essentially the same manner as did the larger panel.

The coefficients of correlation between average panel scores and average trimetric values were 0.968 for the canned samples and 0.910 for the frozen samples. As agreement was not perfect, the result indicates that the correlation between the objective and panel scores might have been even higher, had it not been for the error inherent in the panel scores themselves or for factors not measured by the trimetric tests. In order to indicate the percentage of the variability that is explainable on the basis of differences in test results, the coefficients of determination were obtained as shown in Table 2.

In the case of the canned samples, the tests explained approximately 94% of the variability in tenderness-maturity. For frozen corn the results were similar to those for the canned product, but the accuracy of the tests on the frozen product was somewhat lower. The trimetric test explained about 83% of the variability in tenderness-maturity, whereas about 17% of the variability appears to be due to error in the panel or objective methods or to factors not measured by the trimetric test. This may be attributed at least in part to the greater error in the determination of percentage A. I. S. in the frozen samples caused by variations in blanching and washing, as corn kernels do soak up water during these operations, and reduce the insoluble solids percentage accordingly. Canned whole kernel corn, on the other hand, being processed in liquid, is always tested under conditions of maximum water imbibition.

In another study on sweet corn quality reported elsewhere *(3)*, it was found that the factor of sweetness added precision to the objective evaluation of frozen whole kernel sweet corn. Sweetness was unimportant for canned whole kernel sweet corn, as sugar is added to this product in the canning operation. It is, therefore, possible that the addition of sugar determination to the other tests included in the trimetric test would result in a somewhat more accurate combined test. The practical advantage of such a more elaborate test, however, is questionable.

It may be noted from Table 2 that correlations between panel scores and alcohol-insoluble solids are lower than those between panel scores and all 3 trimetric tests, even for these data on 10 varieties of yellow corn which do not differ widely in their quality characteristics. Had other varieties been included, or other growing conditions, the advantages of the trimetric test over any single test would have been even more apparent.

Nomographs for calculating scores. To receive a score in the Grade A classification, the United States standards for processed corn require that the corn be tender. "Tender" means that the kernels are in the *milk* or *early cream* stage and have a tender texture. Kernels in the pre-milk or "blister" stage of development, which are easily detected visually, have not reached the most desirable stage of maturity and are not satisfactory for canning or freezing. When dealing with samples of sweet corn of this stage of maturity neither the trimetric test nor the nomographs for assigning the tenderness-maturity score gives satisfactory results and is therefore not applicable to sweet corn in this stage of maturity.

The nomographs developed from the relationship between the objective test data and panel scores are presented in Figures 1 and 2. The nomograph presented in Figure 1 may be used to determine the tenderness-maturity score of canned whole kernel sweet corn

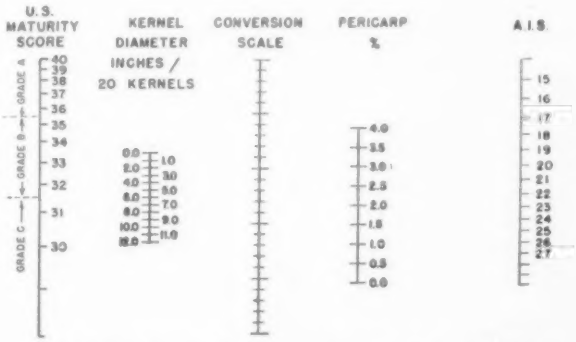

Figure 1. Nomograph for determining U. S. grade for tenderness-maturity of canned sweet corn from determinations of A. I. S., pericarp, and kernel size. From selected points on A. I. S. and pericarp scales, extend line until it intersects conversion scale. From this intersection point, extend line through selected point on kernel diameter scale to tenderness-maturity score scale. This point is the numerical tenderness-maturity score.

from tests of percentage of alcohol-insoluble solids, pericarp, and kernel size of the canned corn. The nomograph presented in Figure 2 may be used to determine the tenderness-maturity score of frozen whole kernel

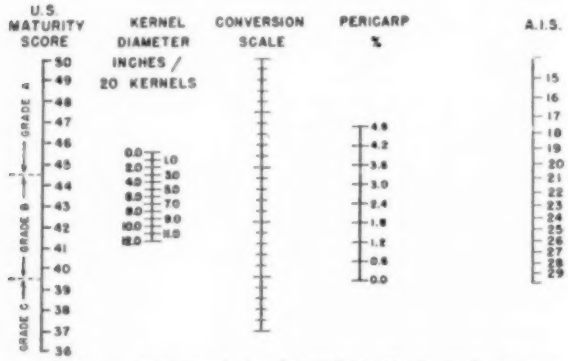

Figure 2. Nomograph for determining U. S. grade for tenderness-maturity of frozen sweet corn from determinations of A. I. S., pericarp, and kernel size. From selected points on A. I. S. and pericarp scales, extend line until it intersects conversion scale. From this intersection point extend line through selected point on kernel diameter scale to tenderness-maturity score scale. This point is the numerical tenderness-maturity score.

sweet corn from the same three tests on the frozen material.

The USDA scores, as well as the actual and predicted trimetric results for the 80 experimental samples, are presented in Table 1. The USDA scores and actual trimetric results were obtained by tests of the processed product, whereas the predicted scores were calculated from test on raw corn conducted by the University of Maryland using the proper nomographs. It may be noted that there is excellent agreement between the USDA scores and those calculated from trimetric data as obtained from the processed samples, and as predicted from data obtained on the original raw corn.

Results with commercial samples. As stated above, this work was undertaken because an objective method for determining the tenderness-maturity of canned and frozen whole kernel sweet corn is needed. A comparison of USDA tenderness-maturity scores obtained on the commercial samples with scores by the trimetric method is presented in Table 3 for 53 samples of canned and 32 samples of frozen corn. These samples were selected because they were of maturity near the dividing line between *fancy* and *extra standard* for the tenderness and maturity factor. When compared with the trimetric scores, the scores by the USDA inspectors were more lenient, on the average.

TABLE 3

Percentage agreement between panel scores, USDA scores, and trimetric values on evaluation of tenderness-maturity of commercial samples of canned and frozen whole kernel sweet corn

	Percentage of scores			
	USDA		Trimetric	
	Canned	Frozen	Canned	Frozen
	Percent	*Percent*	*Percent*	*Percent*
Agrees with panel score	68	75	70	72
Lower than panel score	11	9	15	15
Higher than panel score	21	16	15	13

SUMMARY AND CONCLUSIONS

Results of a study to find a reliable objective test to determine the tenderness-maturity of processed whole kernel corn are presented. The data show a good correlation between the results of the trimetric test, which is wholly objective, and the results of subjective panel evaluation of the tenderness-maturity factor. On the basis of examination of numerous samples, it has been shown that the trimetric test, consisting of percentage of alcohol-insoluble solids, percentage of pericarp, and kernel size may be used with considerable reliability to evaluate the tenderness-maturity of canned or frozen whole kernel corn. In the case of sweet corn in the pre-milk or blister stage of maturity the trimetric method does not give satisfactory results and is therefore not applicable.

Although somewhat less accurate for frozen than for canned corn, this objective procedure may be used to some extent as a guide for in-plant quality control as well as for verification of organoleptic determination of tenderness-maturity. The extent of its practical application may be somewhat limited by the time required to complete the test.

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10. U. S. Department of Agriculture. United States Standards for Grades of Frozen Whole Kernel (or Whole Grain) Corn. (7 CFR, Sec. 52.271) Effective August 1, 1952.

The Effect of Ethylene Oxide Treatment on the Nutritive Value of Certain Foods

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Following the publication of a paper from the U. S. Department of Agriculture in 1928 *(1)* in which the value of ethylene oxide (EO) as a bactericidal fumigant was demonstrated, practical use was made of this substance as a food protectant. Numerous patents have been issued *(2)* covering applications of EO treatment in the sterilization and fumigation of foods and food ingredients. Animal feeding tests indicated the safety of foods so treated.

Nevertheless a recent report *(3)* from the Laboratory of Biochemistry and Nutrition, National Institutes of Health, has raised the question of a possible detrimental effect of ethylene oxide on the nutritional properties of foods, particularly those foods constituting major sources of essential nutrients. This would exclude spices or seasonings, for example, since they contribute only small and insignificant quantities of essential nutrients to the diet. Thiamine was indicated to be one of the factors, though not the only one, destroyed by EO treatment.

Hawk and Mickelsen *(3)* exposed 500 g. portions of "purified" (i.e. casein-sucrose-oil) and stock (dog meal) diets to EO vapor at a concentration of 8.84 g. per 10 liters (corresponding to 5.5 lb. per 1000 cubic feet or 1.77 lb. of EO per 100 pounds of food treated). This level of treatment is higher than that used in commercial sterilization *(3)* which varies from 2 to 4.5 lb. per 1000 cubic feet or, in terms of the usual retort load, about 0.2 lb. of EO per 100 pounds of food treated. For fumigation purposes the atmospheric concentrations of EO are 2.5 to 4 lb. per 1000 cu. ft. but the loads are greater, the ratio being 2 to 6 pounds EO per 10,000 pounds of commodity. Thus the exposure conditions employed by Hawk and Mickelsen were more severe in respect to the EO:food ratio than those used commercially.

It was therefore decided to undertake a study of the effect of EO treatment, under commercial sterilization conditions, on vitamin content and growth promoting activity. Two types of diets were used, viz. a "purified" diet of which only the yeast component was subjected to EO treatment, and a natural, stock diet prepared in these laboratories for chronic toxicity studies; in the latter case the entire mix, exclusive of the fat and fat-soluble vitamins, was exposed to the EO treatment. The composition of the diets is shown in Table 1. One half of a 10 lb. lot of yeast and one half of a 10 kg. lot of the natural diet mix (other than fat), the latter prepared by these Laboratories, were subjected to the EO treatment at Griffith Laboratories, the untreated portion of each lot being reserved for the control diets. The conditions employed in the sterilization procedure and the results of bacteriological and chemical examinations (by Griffith Laboratories) before and after the exposure are summarized in Table 2.

Vitamin Assays

Assays were conducted on the yeast samples and on the natural diet mixtures for thiamine, riboflavin, niacin, pyridoxine, pantothenic acid, folic acid, and choline, the results of which are shown in Table 3.

Small differences in moisture content were noted in the samples before and after exposure to EO but the changes were in opposite directions in the yeast and diet mixes, respectively, and were not significant; hence vitamin content is expressed on the "as is" basis.

It is seen that with the exception of pantothenate in yeast and folic acid and choline in the natural type diet, the assay values after EO treatment were lower than those before treatment. Because of the difficulty in assessing the significance of differences of this magni-

TABLE 1
Composition of diets

Semi-synthetic

Ingredient	Diet A	Diet B
	%	%
Yeast { EO-treated	10	
Yeast { Untreated		10
Sucrose	29	29
Starch	30	30
Casein	20	20
Primex	5	5
Salt mixture[1]	4	4
Vitamin B complex[2]	1	1
Vitamins in Oil[3]	1	1
	100	100

Natural

	Diet C		Diet D
	%		%
Whole wheat	32		32
Yellow corn	16		16
Non-fat milk solids	20		20
Meat meal	10		10
Alfalfa meal	2		2
Dried yeast	1	treated EO-	1
Dried pork liver	0.5		0.5
Cellufluor	1		1
NaCl	0.5		0.5
$MnSO_4$	0.02		0.02
Vitamin B complex[2]	1		1
Primex	15		15
Vitamins in Oil[3]	1		1
	100		100

[1] Hawk, Oser and Summerson, *Practical Physiological Chemistry*, 13th ed. (1954), p. 1375. Blakiston, New York.

[2] Thiamine HCl, 600 γ; Riboflavin, 1200 γ; Pyridoxin, 400 γ; Calcium pantothenate, 4 mg.; Niacin, 5 mg.; Choline chloride, 200 mg.; Inositol, 100 mg.; P-amino benzoic acid, 2.5 mg.; Biotin, 1 γ; Pteroylglutamic acid, 1 γ; Cyanocobalamin, 1 γ; Liver concentrate 1:20, 25 mg.

[3] Vitamin A, 200 USP units; Vitamin D, 20 USP units; α-Tocopherol, 12 mg.; Vitamin K, 100 γ.

tude on the basis of single assays, the same series of vitamins were determined on 5 additional samples of yeast (before and after EO treatment) obtained from different sources. Treatment of the samples with the gas was carried out by Griffith Laboratories using the same procedure (see Table 2) previously described.

The results of the vitamin assays on all 6 samples of yeast have been summarized in Table 3-a, using the same procedures noted in Table 3. The apparent effect of EO treatment has been expressed as percent change after exposure in Table 3-b.

Consideration of these data leads to several tentative conclusions. Thiamine, riboflavin, niacin, pantothenate and choline appear to have suffered no losses of practical significance as a result of EO treatment despite the fact that the average values after treatment are numerically lower than before treatment in the case of all but pantothenate. It is evident that the range of net change observed is quite wide and it may be assumed, in the absence of statistical studies, that the assay uncertainties could account for the difference found. The case of pantothenate is of particular interest due to the apparent substantial increase in this vitamin after treatment noted in two of the yeasts (Tye 2019 and Strain BY). These assays were rechecked several times without discovering any obvious explanation for the anomaly but it is worth noting that the two samples for which an increase was obtained were similar yeasts.

The effect of EO treatment on the pyridoxine and folic acid content of yeast appears more consistent, and it seems probable that these 2 vitamins are somewhat reduced as a result of exposure to the gas under commercial conditions. The degree of this effect, however, is not large, being of the order of 12-14% on the average.

TABLE 2
Treatment and examination of samples

Yeast	Natural diet
Samples: Pure Dry Yeast (Brewers Type), Type No. 2019 from Standard Brands Inc. Retort 2—Batch 1 (Unsterilized and Sterilized). For Feed Study.	Natural Diet — Fat Free Mixture—Retort 2—Batch 1 (Unsterilized and Sterilized).

Treatment: The material was preheated under a vacuum of 29 in. of mercury for 2.5 hours. Ethylene oxide gas was then admitted into the retort on the basis of 0.24% concentration and the material remained under vacuum and gas for 2.5 hours. The temperature was maintained at 130° F. for a total time of 5 hrs. The vacuum was then broken and sterile air passed through the retort for a period of 5 min. At the end of this time the retort was opened and the material removed.

Subsamples	Untreated	Treated	Untreated	Treated
Flat sour spores in 10 g.				
37° C.			TNTC[1]	350
55° C.			TNTC	100
Total thermophilic spores in 10 g.				
37° C.			TNTC	450
55° C.			TNTC	150
Total mesophilic bacteria per g.	1000	Less than 1	2000	Less than 1
Total yeast and mold per g.	Less than 1		12000	Less than 1
pH 10% solution	5.21	5.30	6.40	6.75
Moisture (toluene distillation) percent			8.0	8.0
Fat (ether extract) percent	1.48	1.45	3.68	3.64
Refractive index 20° C.			1.4692	1.4708

[1] Too numerous to count.

TABLE 3
Vitamin assays before and after EO treatment

Vitamin	Procedure	Yeast		Percent change	Natural diet		Percent change
		Untreated	Treated		Untreated	Treated	
		mg. per 100 g.			*mg. per 100 g.*		
Thiamine	Thiochrome[1]	3.24	3.11	−4.0	1.03	0.93	−9.7
Riboflavin	Microbiological[2]	8.60	7.18	−16.5	2.28	2.11	−7.5
Niacin	Microbiological[2]	68.0	60.8	−10.6	7.80	6.73	−13.7
Pyridoxine	Microbiological[4]	1.25	1.00	−20.0	0.32	0.24	−25.0
Pantothenic Acid	Microbiological[5]	11.8	15.2	+29.0	3.49	2.84	−18.5
Folic Acid	Microbiological[6]	1.96	1.51	−23.0	0.13	0.17	+30.8
Choline	Microbiological[7]	318	281	−11.6	308	381	+23.7
Moisture, percent	Gravimetric[8]	5.22	5.70		7.51	6.87	

[1] *Official Methods of Analysis of the Association of Official Agricultural Chemists* (1950), section 40.18.
[2] *Ibid.*, section 40.28.
[3] *Ibid.*, section 40.36.
[4] Siegel, L., Melnick, D., and Oser, B. L., *J. Biol. Chem.*, **149**, 361 (1943).
[5] Novelli and Schmetz, *J. Biol. Chem.*, **192**, 181 (1951), and Skeggs and Wright, *J. Biol. Chem.*, **156**, 21 (1944).
[6] Procedure as described for S. faecalis 8043 in Agriculture Handbook No. 29, U. S. Dept. of Agriculture, September 1951.
[7] Horowitz and Beadle, *J. Biol. Chem.*, **150**, 325 (1943); Siegel, *Science*, **101**, 674 (1945).
[8] *Official Methods of Analysis of the Association of Official Agricultural Chemists* (1950).

TABLE 3-a
The effect of ethylene oxide treatment of vitamin content of yeasts

Vitamin	Yeast sample											
	No. 2019 Brewers		No. 200 Primary a		No. 300 Primary b		Strain BY c		Strain G d		Debittered e	
			Contr.	Treat	Contr.	Treat	Contr.	Treat	Contr.	Treat	Contr.	Treat
	mg. per 100 g.		*mg. per 100 g.*		*mg. per 100 g.*		*mg. per 100 g.*		*mg. per 100 g.*		*mg. per 100 g.*	
Thiamine	3.24	3.11	51.0	53.6	100.5	99.6	2.57	2.41	19.3	17.3	12.6	12.7
Riboflavin	8.60	7.18	10.3	9.02	11.0	11.4	9.50	9.55	10.0	9.30	4.86	5.19
Niacin	68.0	60.8	31.5	33.8	48.6	46.3	55.8	46.3	49.3	45.8	29.8	29.5
Pyridoxine	1.25	1.00	0.39	0.41	0.76	0.65	0.68	0.60	0.74	0.58	1.46	1.28
Pantothenate	11.8	15.2	15.8	15.9	10.7	10.1	11.2	17.1	10.0	10.6	4.23	3.22
Folic Acid	1.96	1.51	1.24	1.16	0.81	0.72	1.27	1.20	1.80	1.46	0.15	0.12
Choline	318	281	186	177	185	225	237	181	184	169	158	145

TABLE 3-b

Change in vitamin content of yeasts after ethylene oxide treatment

Vitamin	Yeast sample						
	No. 2019 Brewers	No. 200 Primary	No. 300 Primary	Strain BY	Strain G	Debittered	Average
Thiamine	−4.0	+5.1	−0.9	−6.2	−10.4	+0.1	−2.7
Riboflavin	−16.5	−12.1	+3.7	+0.5	−7.0	+6.8	−4.3
Niacin	−10.6	+7.3	−9.5	−17.0	−9.3	−1.0	−6.7
Pyridoxine	−20.0	+5.1	−14.5	−11.8	−21.6	−12.3	−12.5
Pantothenate	+29.0	+0.1	−5.6	+52.7	+6.0	−23.9	+9.7
Folic Acid	−23.0	−6.5	−11.1	−5.5	−18.9	−20.0	−14.2
Choline	−11.6	−4.3	+21.6	−23.6	−8.2	−8.2	−5.7

Feeding Tests

Weanling albino rats of both sexes weighing 50 to 70 g. at 21 days of age were divided into 4 groups of 11 or 12 each, balanced with respect to sex distribution and initial weight. They were housed individually in metal-mesh, raised-bottom cages, with free access to fresh water. Food was provided ad libitum, the intake being recorded semi-weekly. Computations of the efficiency of food utilization were made. The rats were examined daily for behavior, physical condition, and survival, and body weights were recorded weekly. The feeding period extended for 5 weeks. Prior to sacrificing the rats for postmortem examination, terminal blood hemoglobin values were determined.

The growth responses of the male and female groups shown in Figure 1 reveal no significant differences between purified diets containing treated and untreated yeast, respectively. The group fed the EO-treated natural diet (Figure 2) showed definite growth depression relative to the control rats on the untreated diet. However the retardation occurred only during the first week the rate of growth thereafter being the same in the test and control rats. This is seen more clearly in Figure 3 where the weekly gains in body weight are plotted in the form of a bar diagram. From the weekly food consumption data in Table 4 it is evident that whereas the weanling rats receiving the purified diets (of which the EO-treated yeast constituted only 10% by weight) required no initial period of adjustment to the diet, those on the EO-treated natural diet manifested, at first, a reluctance to eat as much as the corresponding controls; after the first week, however, the treated natural diet proved more acceptable, the weekly intake approximating that of the controls.

The lower initial gains on the EO-treated natural diet

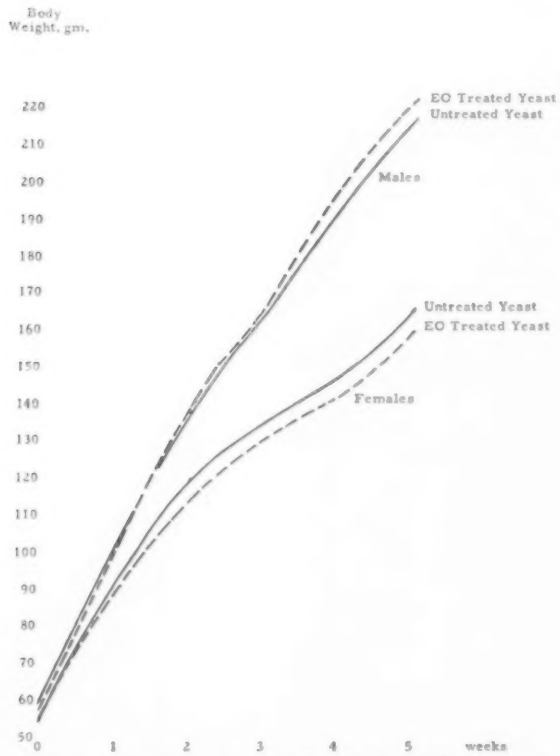

Figure 1. Growth curves of rats fed "purified" diets containing untreated and EO treated yeast.

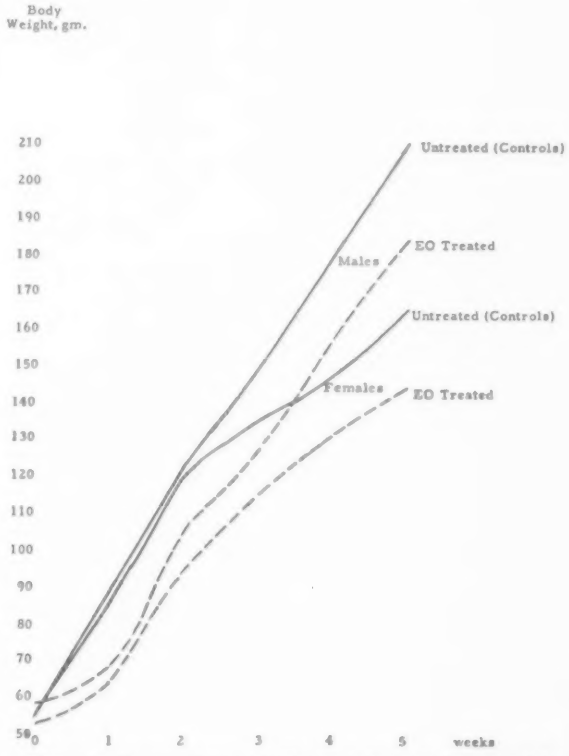

Figure 2. Growth curves of rats fed natural diet (untreated and ethylene oxide treated).

TABLE 4
Food intake (FI) in g. per week and efficiency of food utilization (EFU) in g. gain per 100 g. eaten, by weeks

Diet	Number and sex	1		2		3		4		5		2-5 (incl.) EFU
		FI	EFU	FI	EFU	FI	EFU	FI	EFU	FI	EFU	
Untreated Yeast (Controls)	5M 6F	59.8 59.5	66.2 56.6	85.4 77.0	47.5 41.2	76.8 69.8	33.3 20.9	85.4 75.2	32.1 16.6	74.6 61.2	32.4 29.2	36.3 26.7
EO-Treated Yeast	5M 6F	64.2 57.5	64.8 54.8	96.4 80.0	43.8 34.5	80.4 77.2	31.1 21.6	94.4 79.5	34.1 13.0	79.6 68.8	30.5 26.2	34.9 23.8
Untreated Natural Diet	6M 6F	58.5 54.7	56.9 56.1	90.5 86.0	37.8 41.2	87.2 72.5	29.2 19.7	96.3 69.3	32.7 15.6	80.7 59.0	35.9 31.2	33.9 26.9
EO-Treated Natural Diet	6M 6F	34.2 30.8	28.9 36.4	77.0 74.8	49.1 41.2	85.2 74.8	24.3 26.2	94.7 76.2	32.2 21.9	72.3 51.0	36.8 23.9	35.6 28.4

can not be attributed entirely to diminished food consumption inasmuch as their gains per unit weight of diet eaten (EFU) were actually less than the controls' during the first week. The lower intake of food (and possibly its lower B-vitamin content) may have induced a temporary impairment of food utilization. However this picked up promptly, the mean EFU's for the 2nd-5th weeks, inclusive, being not significantly different ($p = 0.05$) for the test groups on either the purified or the natural diets, from their respective control groups.

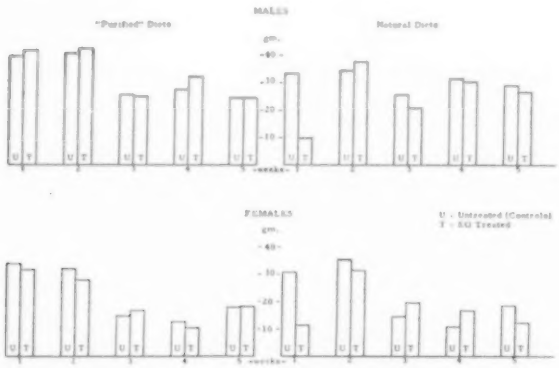

Figure 3. Gain in body weight by weeks.

No abnormalities of behavior or appearance were seen during the course of the feeding period. Blood hemoglobin levels at 5 weeks were normal, the averages being 13.0 and 13.3 g. per 100 ml. for the test and control yeast groups, respectively, and 13.5 and 13.1 g. per 100 ml. for the groups on the treated and untreated natural diets, respectively. All rats survived the 5-week period and gross examination of the viscera revealed no deviations from the normal in either the test or control groups.

CONCLUSIONS

Six samples of yeast treated with ethylene oxide under conditions approximating commercial usage showed slight, insignificant average losses in thiamine, riboflavin, niacin, and choline content. The effect of treatment on pantothenate was erratic but probably of no consequence. Pyridoxine and folic acid, on the other hand, were lost to a degree which may have been significant on the basis of the expected precision of the assay methods.

Similar qualitative results were obtained with respect to a natural type diet which was assayed for its vitamin content before and after treatment with EO.

Despite this slight lowering of the level of vitamins of the B-group, no adverse effects were observed in young rats during a 5-week test period from the inclusion in a purified diet of 10% of yeast treated with ethylene oxide under commercial conditions.

The natural diet mixture (exclusive of the fat component) exposed to ethylene oxide under similar conditions, proved at first to be less acceptable to weanling rats than the untreated control diet. After the second week, however, no significant differences were noted in food intake or growth rates. The diminution in level of B-vitamins in the treated diet, though small and questionable, may have accounted for the lower growth response and efficiency of food utilization observed during the first week when the growth requirement of rats is at a maximum.

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Phase Contrast Microscopy in the Examination of Starch Granules[a]

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The microscope has been the only instrument available by which the character of, and alterations in, separate starch granules may be observed. Variations in techniques have been tried in the use of the laboratory microscope, viewing starch granules by transmitted, reflected, and polarized light, and with various stains. With the exception of polarized light, however, the differences noted among various workers have been quite large. Owing to the increased transparency of starch granules on expansion, these methods have great limitations, and in some cases, it has been necessary to use stains in order to see the image.

The phase contrast microscope provided a sharper tool than was hitherto available. It reveals more of the geometry of starch granules and extends the use of the microscope to include the examination of these more transparent objects. Photomicrographs of starch dispersions using this technique to advantage were shown by Bechtel in 1951 *(1)*. Attention is being given at this time to the physical alterations of starch throughout the cooking cycle because this material is extensively used as a physical modifier of such industrial products, as paper surfaces, food and drug products, cosmetics, and textile finishes.

It is recognized that excellent photomicrographs have been published by optical principles other than phase contrast, as exemplified by Sjostrom *(2)* and Woodruff and MacMasters *(3)*. The instrument used in this work has the advantage of exact reproducibility of field contrast at any time; this makes photomicrographs available as reference material at spaced intervals—a decided advantage for less experienced workers.

The purpose of this investigation was to demonstrate the advantage of the use of phase contrast microscopy in the study of unmodified starches, flours, and modified starches in the raw and processed state, [illegible] demonstrate the advantage of its use as a control on [illegible]ocessing methods.

EXPERIMENTAL

This experimental study was planned to obtain a series of pictures of food starches and flours: in the raw state; at a point before gelatinization peak; at the gelatinization peak as determined in the Brabender pasting curves; at a post-gelatinization temperature of 95° C.; after the sample had been cooked for 15 minutes at 95° C.; and after a sterilization equivalent to that given to a heavy paste.

Each sample was cooked in triplicate or repeated until the granules were considered representative for the selected variations in processing temperatures. Sterilized samples were prepared as described in a subsequent section.

Twenty-four different materials were examined in this series.[e] They included common starches, modified starches, and a series of regularly used flours. Nearly 150 photomicrographs were taken during the course of this study.

Methods of preparation of the slurry. It was decided to prepare the starch slurries in small volume under conditions where the heat penetration was fast and where the granules would get

[a] This contribution is from the cooperative studies of the Multiple Fellowship on Food Varieties, sustained at Mellon Institute by the H. J. Heinz Company, and of the Institute's Division of Microbiology and Microscopy.

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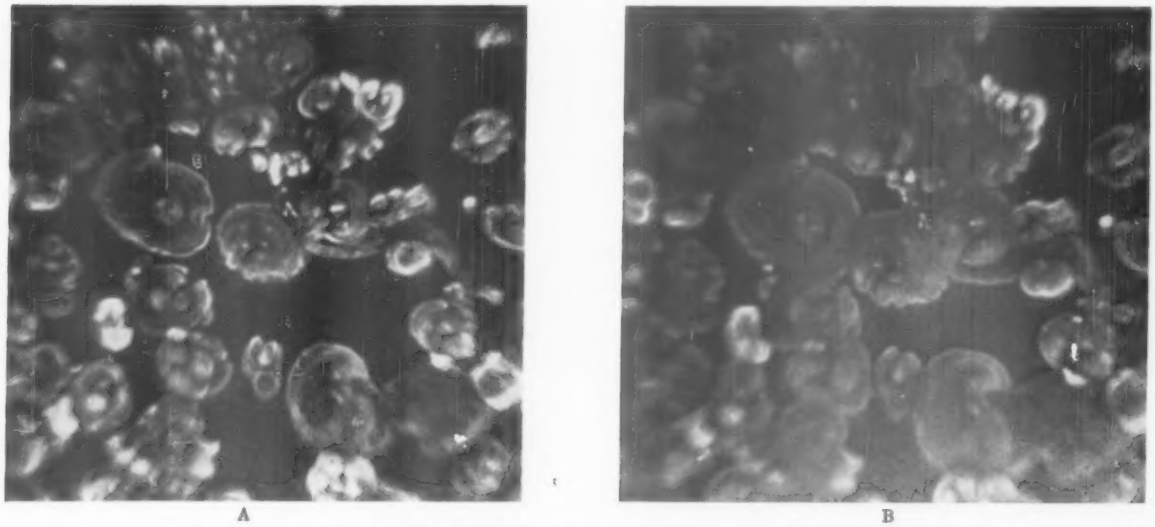
[e] The authors are indebted to the following companies who submitted samples for this investigation: Archer-Daniels-Midland Co., American Maize-Products Co., Corn Products Refining Co., General Mills, Inc., The Hubinger Co., National Starch Products, Inc., Pillsbury Mills, Inc., Quaker Oats, Rice Products Co., J. R. Short Milling Co., A. E. Staley Mfg. Co., Stein, Hall & Co., Inc.



A B

Figure 1. A. Wheat starch cooked to 95° C. viewed immediately after slide preparation. B. The same field after the slide had stood for five minutes, 200 ×, B-M.

a minimum amount of agitation. A glycerin bath was made in a pyrex cylinder, the temperature was elevated by a Fisher Automerse heater with a thermoregulator, and the bath was agitated by a magnetic stirrer and a constant stream of air. A pyrex tube (1-inch diameter) was equipped with a thermometer and a glass stirrer which contoured the tube. The tube was immersed to the top of the slurry, and agitated at a rate of 60 strokes per minute. In most cases the slurries, in concentrations of 1.0 to 3.0%, depending on the starch, were brought to 95° C. in a range of 12-15 minutes. Aliquots were removed at various temperatures during the cooking procedure, depending on the gelatinization peak of the particular starch, by a 1 ml. pipette. The samples were allowed to drain into an equal quantity of diluting fluid. Shortly after preparation of the slurries, the granules were examined and representative fields photographed. The fields were selected after repeated examinations of replicate batches. Sterilized samples in concentrations from 3.0-5.0% were cooked with constant stirring to 85° C. (185° F.), canned in 8 oz. cans, and sterilized at 121° C. (250° F.) for 57 minutes.

Preparation of slides. Great care was exercised in the preparation of slides illustrative of the findings, as the granules were usually quite fragile and susceptible to friction of any kind. It was found that the volume of the drop and the weight of cover slip were critical factors in preparation, and also that expanded granules had a tendency to relax (Figure 1). It was necessary to control the time element between slide preparation and the point at which the photograph was taken. Wheat starch was used in this experimental work since it readily demonstrated the need for controlled conditions.

Since the thickness of the film was critical, a series of Lang-Levy constriction micro-pipettes was made. The one that gave adequate coverage and good phase contrast had a volume of 0.0142 ml. The pipette was used throughout the program except on the raw samples where the particle size was too great, on flours that were too coarse, and on the sterilized products that were too sensitive to fragmentation.

Cover slips of 3 thicknesses, Nos. 0, 1, and 2, were selected within narrow limits of variation by the use of a micrometer. The No. 0 best grade cover slip which had an average thickness of 0.055 mm. was chosen for this investigation.

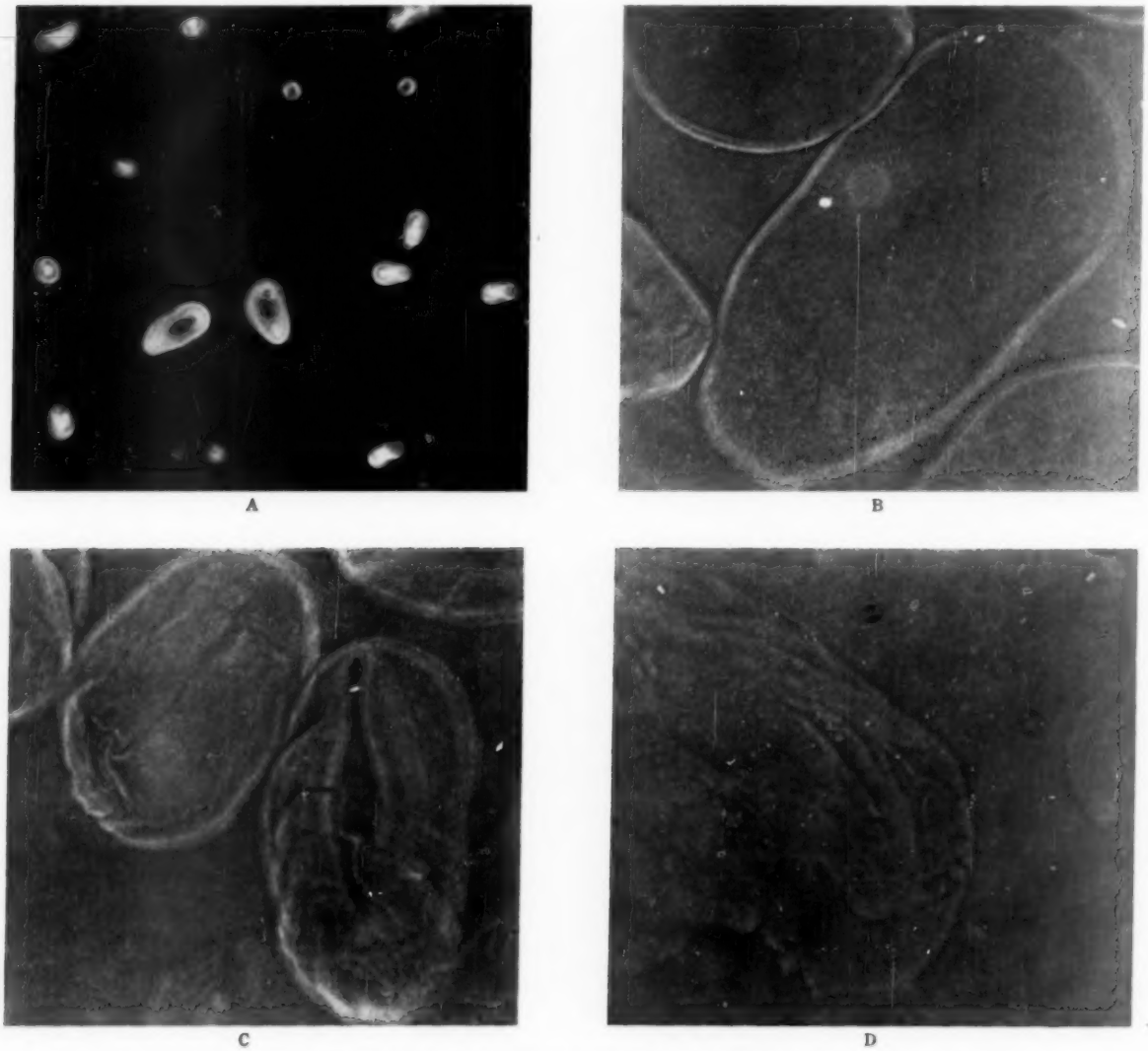
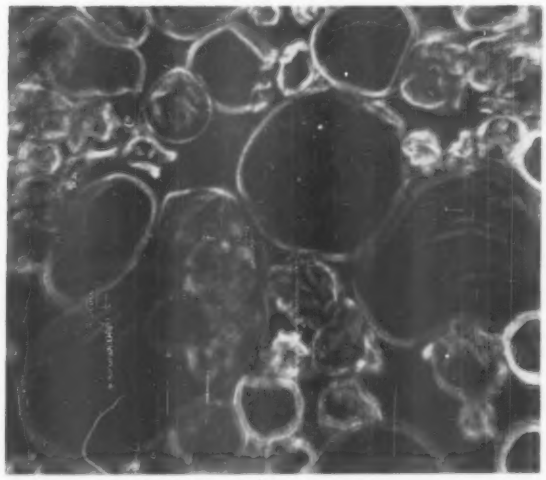


Figure 2. Study of Idaho Potato starch granules throughout the cooking cycle.

A. Raw potato starch, 200 ×, B-M.
B. Cooked to 86° C. (gelatinization peak), 200 ×, B-L.
C. Cooked to 95° C., shows granule rupture, 200 ×, B-L.
D. Sterilized at 121° C. for 57 minutes, 200 ×, B-L.



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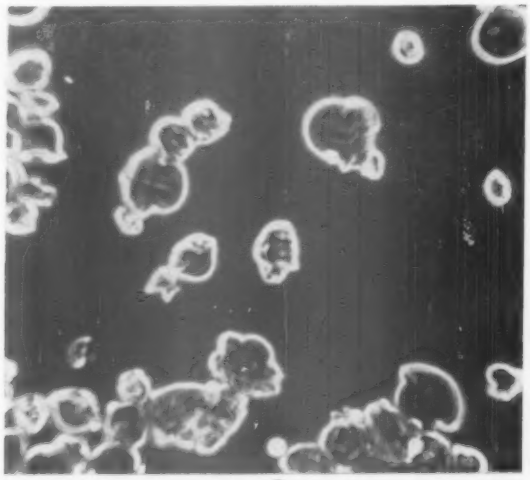

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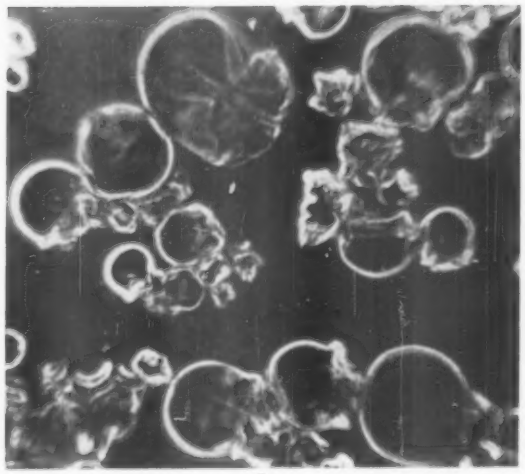


C

Figure 3. Comparison of unmodified and modified tapioca starch granules at similar temperatures.

A. Unmodified tapioca starch at 73° C., 200 ×, B-M.

B. Modified tapioca starch at 75° C., 200 ×, B-M.

C. Modified tapioca starch showing the stability of the granules after sterilization at 121° C. for 57 minutes, 200 ×, B-M.

To control the change in granule appearance due to relaxation, the time for the selection of the field was limited to 3 minutes. An attempt was made to take the photomicrograph within 4 minutes. No pictures were taken after the slide had stood for 5 minutes.

Throughout this critical study of slide preparation, various media for the suspension were tried: glycerin, water, and physiological salt solution. The appearance of the granules was quite different in glycerin, lacking surface detail. The granules appeared to stay in suspension better in the 0.85% salt solution than in water; hence this medium was chosen for the slurry preparation and suspension. Corn starch specimens thus prepared showed some variation in appearance from those prepared in water, probably due to the difference of refractive indices of the two media.

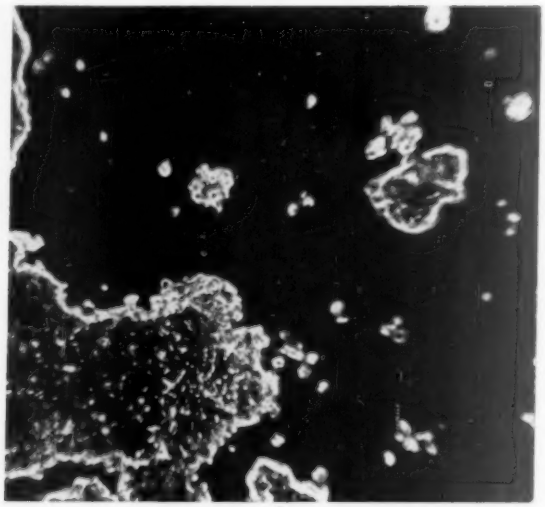
Microscope, objectives, and photomicrographs. The American Optical Company phase contrast microscope with a camera attachment was used in this research. This instrument is equipped with a very complete line of objectives and has a range of magnifications from 100 X to 1940 X. In order to select the proper objectives, a series of examinations was conducted at 430 X with 5 different objectives on a 3.5% corn starch slurry in the raw state, at 88° C. and at 95° C. These included bright-high (B-H), bright-medium (B-M), bright-low (B-L), dark-medium (D-M) and dark-low (D-L) contrasts. It was decided to take pictures at a magnification of 200 X in order to obtain more representative fields. At this magnification, it was found that most starches had sharp images when a bright-medium objective was used, and this objective was subsequently employed unless otherwise noted on the figures. Unfortunately, the raw starches were not as clear with this objective as they had been with the bright-high contrast at 430 X. No bright-high objective was readily available at the 200 X magnification, and so it was necessary to use bright-medium on the raw samples in order to keep the comparisons from raw to expanded state uniform. The granular nature in the raw state contributed to a greater thickness in the film and ideal conditions could not be obtained. When expanded granules became extremely flat, the bright-low objective gave better contrast, and this service was used on some samples, such as potato starch.

All photomicrographs were taken on commercial ortho film (Eastman Kodak Co.). Five- to 8-second exposures were used, depending on the density of the field.

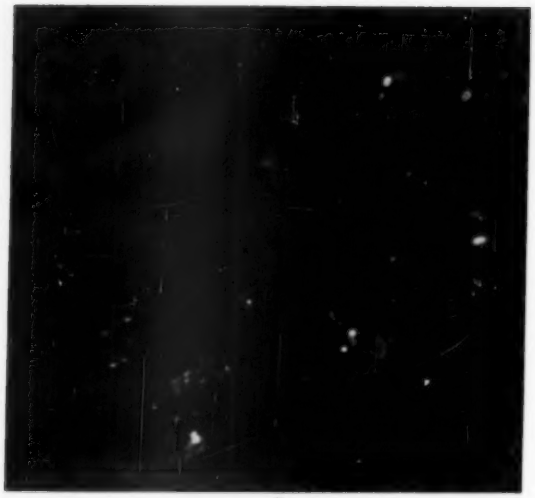
RESULTS AND DISCUSSION

Although this research was designed to accumulate reference material on the normal appearance of starches and flours under various degrees of expansion and to check the effects of higher temperatures on granular material, it has been found useful in many other ways.

A



B



C

Figure 4. Study of proper processing for rice flour.

A. Raw granules.

B. Rice flour cooked at 83° C. for 5 min., then at 88° C. for 5 min. Individual granules show only slight expansion.

C. Slurry given an additional 5 min. cook at 93° C., then further processing at 95° C. for 15 min. All photomicrographs were taken at 200 ×, with the B-M objective.

The phase contrast microscope was shown to be an excellent tool for the examination of starch both as single entities and as part of natural food substances. With its use, we have been able to discover the reasons for the inferior behavior of certain flours grown under adverse conditions by checking the difference in the average size of the expanded granules. As an example, some foreign grown wheats which had abnormally low viscosities were found to have very small wheat starch granules. The phase contrast microscope has been used to determine the degree to which a starch has been cooked when new methods of processing are employed —as, for example, changing from a kettle cooked material to a continuous line process. The procedure is to compare by means of phase contrast microscopy the degree of expansion of the granule in the new plant process with those of a carefully prepared laboratory series of the same thickener.

It is also possible to study the amount of processing needed to achieve the best utilization of ingredient materials. An example is shown in Figure 4. The need for extended cooking of rice flour in order to obtain the maximum expansion of the starch granules is demonstrated. When it is necessary to control the maximum temperature to which a starch should be cooked, adherence to processing details can be quickly checked by comparison with prepared standards. This technique is useful in control work on unsterilized products such as salad dressings or frozen products. Photomicrographs of the results of variances in handling starches can be of great training value since basic phenomena can be presented effectively and quickly to those less familiar with starch technology by this visual method.

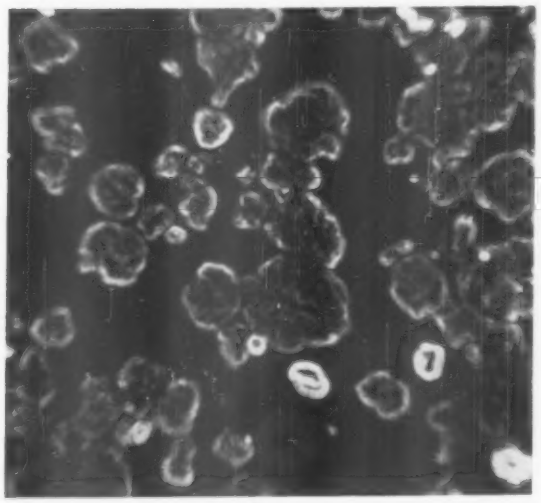
Since only a limited number of photomicrographs can be presented (for space reasons) the illustrations are grouped in these categories: the relaxation of starch granules in slide preparation (Figure 1); comparison of a series of granules throughout cooking and steriliza-

tion (Figure 2); relative differences in the appearance of an unmodified and modified starch at a similar temperature (Figure 3); the resistance of some starch granules to expansion when they occur in the flour complex (Figure 4); and the resistance of some modified starches to ordinary expansion and the stability of the granules during sterilization (Figure 5).

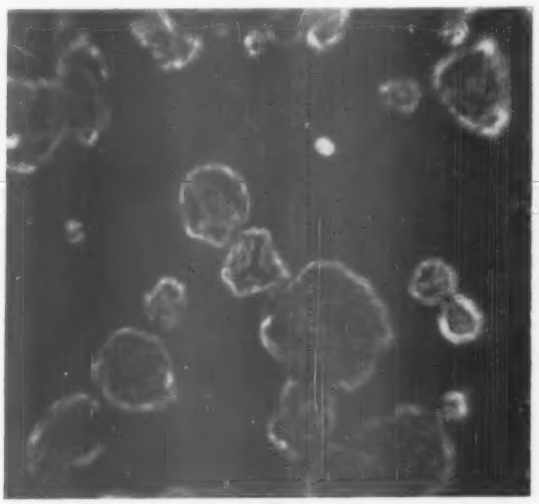
The importance of timing in the examination and recording of granular structure is well illustrated by Figure 1. The same field of wheat starch cooked to 95° C. was photographed immediately after slide preparation and field selection and then after the slide had stood for 5 minutes. The wheat starch granules flattened but still showed considerable surface detail. In other cases, such as some corn starches, the appearance changed from a detailed granule to a flat, nondescript form.

A very good example of granular swelling, rupture and final fragmentation is shown in Figure 2. Idaho Potato Starch which is quite fragile on expansion and has usually been very hard to study microscopically, is shown in great detail in these photomicrographs. Because the granule is so transparent and flattens so decidedly on rupture and fragmentation, it was necessary to change the contrast from bright-medium (B-M) to bright-low (B-L) contrast. It was difficult to find granular material in the sterilized sample.

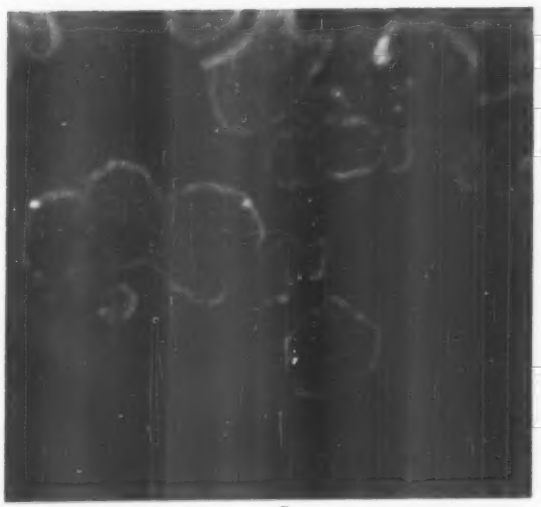
The relative differences in the granular appearance of an unmodified and modified starch cooked to similar temperature are shown in Figure 3. Unmodified Tapioca starch shows the same tendency as potato starch—extreme expansion, rupture and fragmentation. The resistance of the modified tapioca granule to expansion and rupture is well illustrated by restricted size of granules in B and the expanded but well defined granules in C which has had a very complete heat treatment. The sterilized unmodified starch was too fragmented to photograph.



A



B



C

Figure 5. Modified waxy maize starch showing the resistance of some modified starches to ordinary expansion and the stability of the granules during sterilization.

A. Cooked to 85° C.

B. Cooked to 95° C. and held 15 minutes.

C. Sterilized at 121° C. for 57 minutes. The photomicrographs were taken at 200 ×, B-M.

Flours were more difficult to study than starch samples. In some cases, such as oat flour, the granules were thoroughly bound with cellular material and starch granule expansion was not easy to follow. Through the preparation of rice flour for photomicrography, it was found that this variety needed special handling, Figure 4. The granules were not only tightly bound with cellular material, but individual granules were protein coated so that they resisted an iodine stain. They were expanded with difficulty and had to be cooked for 5 minutes at each selected temperature to achieve the expansion shown in the photomicrographs. After cooking an additional 15 minutes at 95° C. making a total of 30 minutes heat treatment, the rice starch showed fully expanded, asteroid-like, transparent granules.

Pasting curves of many modified starches exhibit quite different characteristics from unmodified material of the same variety, in that some modified starches, depending on the degree and type of modification, have no sharp gelatinization peaks but rather a continued increase in viscosity throughout heating and cooling and more stable viscosities during and after sterilization. The photomicrographs in Figure 5 show the early resistance of the modified starch granule to heat, the gradual increase in granule size on continued cooking, and the toughness of the granule throughout sterilization. Degrees of modification can be studied by phase examination using this technique.

SUMMARY

The phase contrast microscope was used to study the granule changes of starches, modified starches, and flours during processing. The work was conducted to develop a series of photomicrographs for use as reference material to show the normal appearance of a wide variety of thickening agents.

A method for preparing slurries and slides is described.

This work was projected to study abnormalities in the granule size of inferior flours, proper methods of processing for complete utilization of some materials, the adherence of large scale production to process details, and to follow the optimum expansion of modified starches.

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The Science of Vanilla Curing

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A review of the scientific work done on the curing of vanilla in an effort to improve the tedious labor-consuming "art of curing" developed over the centuries.

Green beans or pods have no characteristic vanilla flavor. As now commercially produced, a series of operations called "curing" are necessary to develop aroma and flavor in the beans. It has been accepted that vanilla curing is a very highly refined art but one that varies greatly in the various producing areas.

Like so many natural products, the aromatic flavor ingredients of vanilla beans are end products of decomposition or result from the breakdown or splitting of more complex and substantially flavorless ingredients. These decomposition or breakdown products may in turn react or combine to form more complex ingredients of varying flavor value. We are interested in those conditions that will develop in green vanilla pods a maximum of optimum vanilla flavor.

A rapid scientific cure of green vanilla pods is considered by many as the only answer to the many ills of the vanilla industry. The task is a difficult one and although attempted as early as 1916 *(7)* no compilation of the various work done on vanilla curing has been published. Before attempting any work on vanilla curing such a review is desirable.

The foundation for any scientific research on better curing methods would be the work done at the Puerto Rican Agricultural Experimental Station with the cooperation of the U. S. Department of Agriculture. Here the various curing methods used in the different vanilla producing areas were studied. This original comparison of methods *(4)* resulted in the conclusion that a modification of the Guadeloupe method (scratching the bean with a pin) to kill or wilt the green bean gave the best results. Later work, in conjunction with vanilla flavor experts, led to the conclusion that, in general, several methods were satisfactory and their work shifted to the determination of the factors during the various stages of curing that gave optimum flavor development. These investigations have been conducted over a period of at least 15 years and are by no means complete. Recent work has limited some of the processing conditions however, and made it obvious that earlier patented *(9)* commercial "quick cures" were not made under optimum processing conditions. Nevertheless, recent samples of well-aged "vanilla fruit," made according to the above

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patent or a modification thereof, were examined in this Laboratory and found to be of acceptable quality.

CHEMICAL AND TECHNOLOGICAL ASPECTS

Green vanilla beans contain a number of heterosides that are split by the action of enzymes to form aromatic flavoring materials. For example, the precursor of vanillin is a glucoside, glucovanillin (or vanilloside). Under the action of a hydrolytic enzyme which has been established to be of the nature of a beta-glucosidase, the glucovanillin is split to form vanillin and glucose. Glucovanillin has been shown by Arana *(1)* to be fairly widespread throughout the bean, 40% in the blossom end, 40% in the middle and 20% in the stem end. The hydrolytic enzyme, however, is concentrated in the fleshy part or thick walls of the pod. The various killing or wilting treatments in curing are necessary to stop the natural vegetative processes; they work on the microscopic cells that make up the flesh of the beans in such a way that the enzyme therein can act upon the glucovanillin which occurs throughout the whole pod.

All curing methods consist of three steps and if we consider conditioning, where important flavor changes take place, four. These are: wilting or killing; sweating; drying; conditioning or aging.

As already pointed out, the original work *(4)* on the comparison of curing methods established that the scratching of both sides of the green beans with a sterile pin (modification of Guadeloupe method) was the most efficent wilting process. It was found that other efficient wilting operations consisted in heating in an oven at 60° C. for 36-48 hours, placing in hot water at 60-65° C. for 2-3 minutes, or laying the beans in the sun for 1 to 2 hours daily for 17-30 days. For consistent end results and ease of use, the hot water method (Bourbon) was generally adopted in later experiments at Puerto Rico.

"Sweating" consists of a series of operations in which the beans are placed in the sun or heated in an oven, followed by storage in a "sweating box" in which the beans are wrapped in blankets. This operation is repeated until the beans have the right texture and color as determined by the master curer.

Drying is effectively done in an oven, by air drying or a combination of air and sun-drying. Beans are usually dried to the highest moisture content possible without affecting the keeping quality of the beans. The higher percentage of moisture gives more flexible beans and beans with better appearance. The better green pods can be cured to attain beans with higher moisture without danger of spoilage.

Conditioning is simply storage of the dried beans in boxes for three to six months or longer to develop the "perfume" of vanilla. Frequent inspections are made to eliminate mouldy or defective beans.

ROLE OF ENZYMES

Arana *(2)* studied the effect of harvesting on the quality of the finished cured bean. He determined that the *hydrolytic* enzyme responsible for the formation of vanillin from its parent glucoside shows maximum activity in *split*, blossom end yellow beans, medium activity in blossom end yellow beans, and negligible activity when the beans were green. He also showed that the glucovanillin content of beans apparently increased during ripening from the blossom-end-yellow to the chocolate stage. We can surmise that under-ripened beans will be lower in glucovanillin than the riper pods. The conclusion that is reached is that the curing of green beans usually results in an inferior product and indications are that a somewhat lower glucovanillin content, but of more importance, lower enzymatic activity, is responsible. The fact that cured green beans are often acceptable in quality indicates that the hydrolysis of glucovanillin is not the only important flavor change taking place during curing.

Storage of harvested green beans showed a gradual increase in enzyme activity with maturation. Storage beyond 10 days showed a decrease in enzyme activity which was reactivated to its original level during curing. Thus the disadvantages of harvesting green beans can be partly compensated for by judicious storage.

Rabak *(7)*, as early as 1916, in his experiments on quick curing vanilla found that high temperature or prolonged immersion in hot water had an adverse effect on vanilla quality. His work was confirmed later in Puerto Rico. It is probable that wilting at 60-80° C. in hot water for the proper length of time gives good results. A 2-minute immersion at 65° C. or three 10-second immersions at 30-second intervals at 80° C. give satisfactory results. It has not been established accurately that these are necessarily optimum conditions. The wilting procedure will vary somewhat with the size and condition of the green pod. It would seem logical that if the beans are to be chopped or cut this would best be done after the killing or wilting to lessen the danger of enzyme deactivation by elevated temperatures.

Accompanying the liberation of vanillin during curing is the gradual change of color from green to brown. This starts immediately after wilting and the color change is largely completed during the sweating operation. Rabak's work showed that excessive killing by prolonged exposure to elevated temperature also inhibited the browning system of the bean. It has also been demonstrated that the expressed juice of vanilla beans did not turn brown if kept from contact with air *(5)*. Thus, although the formation of vanillin does not require oxygen, the browning of the bean does.

Balls and Arana *(3)* studied the fate of a peroxidase enzyme known to be present in green beans during the curing process. They found that this enzyme was resistant to various methods of wilting the beans and survived a lengthy conditioning period very well. A *crude* peroxidase obtained from green vanilla beans oxidized vanillin, in vitro. They concluded that the peroxidase system is complete in vanilla beans, even after curing is finished. Peroxidase, in their opinion (based on their knowledge of that date), played an important part in the oxidation that takes place during curing. They surmised that vanillin, once formed from the parent glucoside, might be further oxidized with the production of quinone bodies of more complicated structure. They pointed out, however, that the emphasis they placed on peroxidase should not be taken as indicating it was the only oxidative enzyme of importance involved since there was qualitative evidence of an oxidase enzyme in green vanilla beans.

Jones and Vincente *(5)* stated in 1949, as a result of their investigations, that there are two oxidizing enzymes in the whole tissue of the vanilla bean. One, a peroxidase, uses hydrogen peroxide. The second, a type of oxidase or aerobic dehydrogenase, utilizes molecular oxygen as acceptor for hydrogen removed from phenols that are being oxidized to stable pigments. It is certainly justified to say that there is in the vanilla pod an oxidizing enzyme system that is adversely affected by too high or prolonged a temperature treat-

ment and requires oxygen to complete its activity. This system is responsible for the browning of the beans during curing. The crude peroxidase of Balls and Arana *(3)* was undoubtedly the complete oxidizing enzyme system.

Jones and Vincente *(5)* were able to confirm that green beans have little enzymatic activity, that blossom end yellow beans show greater activity at the blossom end but were inactive in the middle and at the stem end. Browned sections of beans showed high activity. By performing their tests in an atmosphere of nitrogen they showed that molecular oxygen is necessary for the main enzymatic formation of quinone bodies in vanilla (noted above). They found that the enzyme system was sensitive to cyanide, thereby indicating the probable presence of a heavy metal. Tests also showed that the main action seemed to be oxidation because oxygen was required as an acceptor and the system was inactivated by carbon monoxide.

Additional work was done by Vincente and Jones and at later dates by other experimentors of the Puerto Rican Experimental Station to determine the optimum operating conditions of the oxidative enzyme system of the vanilla bean. To study the effect of the enzyme in later stages of curing, the system was inactivated by autoclaving at 120° C. *(6)*. Although oxidase, catalase and peroxidase activity were destroyed by autoclaving, a small amount of peroxidase activity apparently appeared later. Samples of beans were autoclaved at the following stages of curing:

a. Immediately after killing or wilting.

b. Two days after killing.

c. At the end of sweating (12 days after killing).

d. At the beginning of conditioning (1 month after killing).

The samples autoclaved after killing stayed green for several weeks and finally became greenish yellow. The beans deactivated 2 days after killing were light brown and had a less disagreeable aroma than the first sample. Beans allowed 12 days enzyme activity were more like the controls except lighter and less developed in aroma. Beans autoclaved 1 month after killing were similar in quality to the controls. The conclusion reached was that enzymatic transformations are important during killing and gradually became less so until, by the end of the sweating period, enzymatic changes *may* be unimportant. The principal changes brought about by enzymes occurred during the first 2 weeks of curing.

Oxidase activity, as well as that of peroxidase, "came back" to the autoclaved beans. Jones and Vincente *(5)* pointed out that recent advances in the science of non-enzymatic browning opened the possibility that the chemical reactions that indicated enzyme activity may have occurred because of the chemical reactivity of products formed during the non-enzymatic browning reactions. If this proved to be true, it would be evident that although the hydrolysis of glucovanillin and other heterosides and part of the coloration was due to enzymatic activity, a considerable part of the flavor development could be due to non-enzymatic activity. Further work was needed to clarify this point.

As additional proof that an oxidase was the principal enzyme responsible for the coloration of beans, autoclaved beans were infiltrated with various enzymes and combinations of enzymes from other known sources *(5)*. The oxidase enzyme obtained from frozen mushroom gave a product most closely resembling the standard vanilla.

OTHER FACTORS IN CONDITIONING

Jones and Vincente in another paper *(6)* studied the effect of various conditioning temperatures on the quality of the finished product. Cured beans were conditioned for 6 months at temperatures of 13°, 17°, 35° and 45° C. Odor and flavorwise, the beans conditioned at the higher temperature were preferred. An interesting side effect that we feel cannot be ignored was the fact that the beans conditioned at higher temperatures also had the lower moisture contents. (Invariably well-aged beans from conventional curing also have lost a substantial quantity of water). The authors concluded that the beans conditioned at 45° C. were completely cured in three months. Although we must logically conclude that aging is the important factor in producing fine vanilla flavor and that this may be accelerated by an increase in conditioning temperatures, we cannot ignore the possibility that a low moisture content at this stage of curing might be the/or a criterion of aging.

In 1951, with the vast knowledge acquired from previous investigations at that station, Rivera and Hageman *(8)* ran additional tests in Puerto Rico on the optimum conditions for vanilla curing. They found, for example, that the storage of killed, ground beans at higher oxygen levels had a deteriorating effect. In a like manner it was found that oxygen does not seem to affect vanillin content or the flavor quality during conditioning. The relation of browning to oxygen absorption was investigated and it was decided that *the browning of the beans* and the absorption of oxygen *is apparently determined by the presence of enzymes*. These enzymes can be inactivated by autoclaving and a drastic drop in oxygen absorption with little or no browning is then noted.

Effect of temperature and light. Next the effect of temperature and light on the absorption of oxygen was studied and the following results obtained. First, the effect of temperature on oxygen absorption, prior to drying, was determined by placing samples of freshly killed beans in flasks connected to a constant oxygen supply. Three lots—at room temperature, 38°, and 48° C.—were run and a record of oxygen consumed for 16 days was kept. From the amount of oxygen consumed it was concluded that a temperature of more than 38° C. was apparently detrimental to the absorption of oxygen, probably because the enzymatic system is adversely affected by the higher temperatures.

The effect of light on oxygen absorption was also determined. Samples of beans were placed in a dark room while others were irradiated continuously with

two fluorescent lamps at a distance of 2½ feet from the flasks. The beans under continuous irradiation absorbed nearly twice as much oxygen as those kept in the darkness.

Finally beans were dried in an oxygen free atmosphere by replacing the air with nitrogen. These beans remained completely green while kept under nitrogen and actually had higher vanillin and total phenol contents than the control. The controls had a better aroma and gave superior extracts, however, indicating that the action of oxygen on vanillin and other phenols results in browning and additional flavor developments. Beans standing 18 days under nitrogen still retained the ability to absorb oxygen and turn brown.

ASPECTS OF CURRENT STATUS

What then have these scientific investigations shown us about the four steps of vanilla curing? First of all, it is obvious that beans should not be harvested before their blossom-end is yellow. If vanilla purchasers saw the advantages of and found it advisable to purchase split, cut or chopped beans, the likelihood of proper harvesting would be enhanced. Secondly, since the production of vanillin, assuming proper harvesting, depends upon the thorough distribution of hydrolytic enzyme throughout the bean, splitting, scratching the surface or chopping of the bean is desirable to promote the more intimate contact of enzyme with heterosides.

Rabak *(7)*, as reported earlier, in his very early experiments on quick curing studied the effect of temperature on wilting. He found that high temperatures or prolonged immersion in water (using the Bourbon method of wilting) had an adverse effect on vanilla quality. It is probable, from the work of many experimentors, that wilting at 60-80° C. in hot water for the proper length of time gives good results.

Rabak also found that sweating and drying at elevated temperatures gave inferior beans to those cured at room temperatures. Unfortunately, the elevated temperatures he spoke of fluctuated between 40-60° C. and his work only proves that 60° C. is too high but that between 40-60° C. may not necessarily be detrimental. Rivera and Hageman *(8)* showed that 38° C. was the optimum temperature for sweating, that oxygen is necessary and that some light is beneficial. Although Vincente and Jones *(6)* had previously found that temperatures up to 45° C. accelerate conditioning, it is possible that that temperature may be somewhat high and 38° C. might be a safer conditioning temperature as well as the proper temperature for sweating and drying.

With this previously compiled and correlated information on curing it is possible to set up a theoretical optimum process for curing vanilla. Yet there are obvious discrepancies between attempts at quick curing and the present "art" which produces a satisfactory product.

The question one would logically ask from the compiled work on vanilla curing is if sweating, drying, and conditioning are all done at 38° C., can they be classified as three different steps? As practiced by the curer in the vanilla producing areas, they are three distinctly different operations. In the work done on quick curing by Rabak *(7)* and Rivera and Hageman *(8)*, the sweating and drying operations were indistinguishable.

Other factors that need clarification are obvious from this review but nevertheless a tremendous amount of fine groundwork has been laid for the chemist or the technical group that wishes to study the scientific curing of vanilla. The rewards are promising from such a project.

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A Preliminary Investigation of the Quick Curing of Vanilla Beans

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(Manuscript received October 15, 1955)

The art of vanilla curing has reached its crossroads. One cannot study the tedious and painstaking care needed for the curing of good vanilla and not be impressed with the immense amount of labor needed. The increased cost of this labor has multiplied the problems of the vanilla manufacturer, who is finding it more difficult to place a standard, consistent pure vanilla flavor on the market and be competitive.

A number of technical men in the industry who are familiar with the various problems involved see as a possible long range solution scientifically determined shortcuts in curing that will greatly reduce curing costs and yet will increase the quality and give a consistent finished product. This problem is one too large in scope and too important to the industry as a whole to be properly investigated by a single investigator or a single firm. Before such a program could be recommended, however, it would be advisable to determine its chance of success.

Our investigation of vanilla curing consisted of three separate studies as follows:

A. We made a complete study of the published work on vanilla curing and correlated the experimental results of the many investigators *(1)*. With this previously compiled and correlated information and coupled with our second study, we were able to set up a theoretically optimum process for rapidly curing vanilla.

B. Actually preceding to some extent the first study but run concurrently for the most part was the examination of hundreds of lots of conventionally cured beans in the presence of a dependable, expert curer. The odor and flavor of the bean and the extract produced from these beans was related to the native methods used in curing and recorded. Thus we learned what steps were taken in various producing areas to give desirable flavor qualities to the cured beans. This study also included the investigation and analysis of several lots of "quick cured" beans and relating their flavor advantages and deficiencies with changes in curing methods.

C. This present study was an exploratory laboratory attempt at quick curing green beans. In this work we attempted to show that by a study of curing methods and their effect on flavor and correlating the scientific work on vanilla curing, one was in a good position to improve upon and speed up present curing methods. Approximately two pounds of freshly picked green beans (which are difficult to obtain) were flown to us from Puerto Rico and used in these experiments. Because of the small sample available, relatively small lots were used and evaluation was made primarily by odor of the cured bean.

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EXPERIMENTAL PROCEDURE

The green pods were almost entirely green, a small percentage showing tips slightly yellow and a fair percentage splitting due to loss of moisture in transit. The green pods had no vanilla odor but a characteristic green odor resembling that of 3-hexenol-1. During curing, the green odor gradually disappeared, first giving indications of aromatics normally associated with protein degradation and then developing a sweet vanillin-malty odor. The characteristic vanilla bean odor did not appear until after several weeks conditioning.

In our first experiment we followed the theoretical optimum rapid cure we had designed from our study of curing methods, and the work of other investigators. The results of this experiment prompted several modifications for which the procedures are given below and summarized in Table 1.

Procedure. *Experiment No. 1.* One hundred and five grams of green beans (not split—slightly yellow tips) were bundled and dipped into hot water at 65° C. for 3 minutes. The temperature dropped to 60° C. when beans were added but increased gradually to 68° C.

The wilted beans were cut in ¼-⅜ inch lengths and placed on a stainless steel tray in an oven at 38° C. for 24 hours. The odor of these beans, which had lost considerable moisture, was sweet but not like vanilla. The pieces were brown with green edges still obvious. These partially dried beans were then wrapped in wax paper and placed in a jar in an oven for approximately 68 hours at 38° C. Beans were more uniform in flexibility and entirely brown. Odor was undeveloped.

Beans were unwrapped and placed on tray in oven at 38° C. for 4 hrs. to dry.

Final weight of beans: 25.0 g.

12.5 g./called Experiment 1A (see Table 1).

12.5 g./subjected to ultraviolet radiation for 2 hrs./called Experiment 1B (Table 1).

Experiment No. 2. One hundred and six grams of green beans (not split) were dipped into hot water at 65° C. for 2 minutes.

The wilted beans were cut in ¼-⅜ inch lengths, wrapped in waxpaper, placed in jar at temperature of 38° C. for 48 hours.

Final weight of beans: 30.0 g.

15.0 g./called Experiment 2A (Table 1).

15.0 g./placed under ultraviolet light for 10 hrs./called Experiment 2B (Table 1).

Experiment No. 3. Two hundred grams of green beans (not split) dipped into hot water at 65° C. for 3 minutes.

The wilted beans were cut in ¼-⅜ inch lengths, wrapped in waxpaper, placed in jar at temperature of 38° C. for 28 hours. Removed from jar, unwrapped, and placed on tray in oven at 38° C. for 48 hours.

Final weight of beans: 43.0 g.

Conditioned in closed jars at *circa.* 38° C.

Vanillin crystallization developed after 2 weeks' conditioning.

Bean odor developed after 1-2 months.

Experiment No. 4. One hundred and sixty-seven grams of green beans (not split—smaller in size) dipped into hot water at 65° C. for 2½ minutes. Seventy-three grams of above wrapped in aluminum foil and placed in oven at 38° C. for 28 hours. After removal from foil, beans were cut in ¼-⅜ inch lengths, placed on trays in oven at 38° C. for 48 hours.

Final weight of beans: 16.0 g./called Experiment 4A (Table 1).

Slight vanillin crystallization noted after two weeks' conditioning.

TABLE 1

Experiment no.	Wilting (Hot water at 65° C.)	Sweating	Drying [1]	Conditioning	Remarks on odor
1A	3 mins.	Cut in pieces—Placed open in oven at 38° C. for 24 hours.	Oven at 38° C. for 4 hrs. (open)	app. 38° C. 6 months	Fair
1B	3 mins.	Cut in pieces—Placed open in oven at 38° C. for 24 hours.	1A plus 2 hrs. ultraviolet	app. 38° C. 6 months	Not as good as 1A
2A	2 mins.	Cut in pieces—Wrapped in waxpaper—oven at 38° C. for 48 hours.	Oven at 38° C. for 30 hrs. (open)	app. 38° C. 6 months	Superior to 1A
2B	2 mins.	Cut in pieces—Wrapped in waxpaper—oven at 38° C. for 48 hours.	2A plus 10 hrs. ultraviolet	app. 38° C. 6 months	Not as good as 2A
3	3 mins.	Cut in pieces—Wrapped in waxpaper—oven at 38° C. for 28 hours.	Oven at 38° C. for 48 hrs. (open)	app. 38° C. 6 months	Very good. Pronounced vanillin crystallization [2]
4A	2.5 mins.	Uncut wrapped in foil—oven at 38° C. for 28 hrs.	Cut in pieces—oven at 38° C. for 48 hrs. (open)	app. 38° C. 6 months	Good—not as fine as 3. Slight vanillin [2] crystallization
4B	2.5 mins.	Cut in pieces—open in oven at 38° C. for 30 hours.	Wrapped in waxpaper—oven at 38° C. for 28 hrs.	app. 38° C. 6 months	Fair—inferior to 3
5	2 mins.	Cut in pieces—Wrapped in waxpaper—oven at 38° C. for 28 hours.	Oven at 38° C. for 48 hrs. (open)	app. 38° C. 6 months	Excellent. Pronounced vanillin crystallization [2]

[1] Lengths of time in drying stage determined by condition of the beans.
[2] Whereas vanillin crystallization is not a criterion of vanilla quality and is not necessary for high quality beans, it invariably indicates good quality and lower moisture and is desired by some manufacturers.

Remainder of wilted beans (49 grams) were placed in tray in oven at 38° C. for 30 hours after being cut in ¼-⅜ inch lengths. They were then placed in closed jar, wrapped in waxpaper for 28 hours.

Final weight of beans: 23.0 g./called Experiment 4B (Table 1).

Experiment No. 5. One hundred and ninety-eight grams of green beans (split) dipped in hot water at 65° C. for 2 minutes.

Beans cut in ¼-⅜ inch lengths, wrapped in waxpaper, placed in closed jar for 28 hours at 38° C. for 48 hours.

Final weight of beans: 46.0 g.

Vanillin crystallization noted after two weeks' conditioning.

CONCLUSIONS

It is not intended that from such limited experiments on one small lot of beans any definite conclusions should be drawn. What was attempted was a confirmation of the work of many investigators on the optimum conditions of vanilla curing. Their work indicates and these limited tests confirm that a satisfactory vanilla bean, odorwise, can be obtained by the following procedure:

a. *Wilting.* Immerse the green beans (blossom end yellow) in hot water at 65° C. for 2 to 3 minutes depending on the size and condition of the bean.

b. *Sweating.* Cut wilted beans in ¼-⅜ inch pieces, wrap in waxpaper and heat in an oven (38° C.) in a closed container for approximately 48 hours.

c. *Drying.* Place open trays in oven (38° C.) for approximately 48 hours.

d. *Conditioning.* Place in closed containers and store at 38° C. for 2 to 3 months—although lower temperatures and longer times will probably give similar results.

These preliminary tests indicated something that previous investigations had perhaps not made sufficiently evident. A high moisture content is mandatory during the sweating operation to facilitate hydrolytic enzymatic activity. This confirms the general practice of curers today who wrap the beans in blankets during this stage of curing. Some of the earlier attempts at quick curing eliminated this step and the omission was unfavorably reflected in the flavor of the finished product. In all other respects, this work confirmed the experimental results obtained at the Puerto Rico Agricultural Station and gives every indication of cutting curing time without any detrimental effect on vanilla quality.

What is now necessary is a cooperative research program between vanilla chemist, curer, and grower on larger lots of beans to work out a more definite commercial method of curing. The above procedure, or modifications thereof, should be used on green beans of various stages of ripeness. Extracts must be prepared and compared with conventional extracts for analytical constants as well as flavor quality. A number of vanilla chemists representing extract houses using large quantities of beans have commented very favorably on the results of these preliminary laboratory cures.

Additional work will also be necessary before the exact role of light in vanilla curing can be thoroughly understood.

Acknowledgment

Our sincere thanks are extended to Dr. L. Hall of McCormick Company for samples of rapidly cured vanilla beans and Messrs. Rosenbaum (David Michael & Company) and Pennington (Mayaguez, Puerto Rico) for their aid in procuring the green vanilla pods. We also wish to thank Mr. Cagigal (Camax Co.) for his advice as a curer and for samples of rapidly cured vanilla beans. The willing assistance of my associates, Messrs. DiGenova and Merwin and the entire Givaudan organization in this non-commercial research was most generous.

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Spectrophotometry of Yellow Sweet Corn

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A spectrophotometric study of the reflectance properties of raw yellow sweet corn was undertaken to determine the possibilities of utilizing these data for rapidly and automatically sorting this material. Three methods of utilizing the reflectance data are described. The correlation of the results obtained by each method with moisture content, which was assumed to be a measure of maturity, is discussed. An experimental photoelectric photometer was built to indicate how the reflectance properties of the corn can be utilized in an instrument design.

Problems of sorting agricultural products on the basis of color for processing and utilization have prompted the development of objective methods. Many food processing industries rely on costly manual sorting crews, utilizing their subjective appraisal experience to effect a separation of the product into various color categories. Although the human eye is extremely sensitive, errors arise due to eye fatigue and faulty judgment. In addition, the visual mechanism varies among individuals and consequently variations among judges with regard to acceptable color sometimes occur. For these reasons the development of objective methods of color evaluation would increase both the efficiency of handling and uniformity of the final product.

A recent contribution of this kind has been made for the lemon industry by Powers, Gunn and Jacob *(9)*. They have shown how the variation in reflectance properties of lemons with maturity can form the basis for an automatic sorting instrument. Another agricultural product for which color sorting is important is yellow sweet corn. At present color sorting based on visual judgment is used by the corn processing industry to segregate the immature and overmature ears from those considered highest in quality.

Eastmond, Peterson, and Stumpf *(2)* presented some spectrophotometric data which indicate the possibility of developing a photometric method for distinguishing color differences within varieties of yellow sweet corn. The present paper considers in detail the relation between the reflectance properties of individual ears and their moisture content over a wide maturity range. Methods of utilizing these data as the basis for a technique to measure maturity are discussed.

PROCEDURES

Moisture data. A requirement for the success of a photoelectric method is the existence of a satisfactory correlation of results with quality of the product. In this study moisture content has been assumed to be a reliable index of quality, and consequently the correlation between the reflectance properties of yellow sweet corn and moisture content has been investigated. Carter, Olson, and Henry *(1)* have compared vacuum-oven moisture determinations with organoleptic tests and have concluded that moisture is correlated with maturity, and that it is difficult to distinguish, by organoleptic methods, samples of processed corn that differ by less than 2% in moisture when harvested.

For the present study the samples (Golden Cross T Strain) were grown by the University of California in Albany, California, and harvested from one planting on four different mornings. They were transported less than one-half mile to the Laboratory, where all data were obtained with a minimum of delay. A sample for the moisture determination consisted of raw kernels cut from an area of about 2 square inches near the central portion of one ear, after reflectance data from this area had been obtained. After blending with an equal weight of water, duplicate aliquots of the mixture were predried in a forced-draft oven for 16 hours at 60° C. (140° F.). Final drying was accomplished in a vacuum oven at 70° C. (158° F.) over a 40-hour period.

The variation in moisture content of the individual ear was determined. The cob was divided into 3 radial and 3 longitudinal regions making a total of nine. Moisture determinations were made by the same vacuum-oven method on the kernels of each region. The standard deviation from the mean percent moisture of the ear varied for different ears from 0.6% to 3.1%, with an average of 1.8%. Most of the variation of a single ear occurred in the longitudinal direction, with averages 0.2 to 3.7% higher than the mean for regions near the silk end and 0% to 2.0% less than the mean at the stem end. The central region showed the least average difference from the mean and the best uniformity, with average values ranging from 0.2 to 1.6% moisture below the mean value for the ear. A central area on each ear was selected for the spectrophotometric study, thereby minimizing variations. All reflectance and moisture data were obtained as nearly as possible from the same area.

Reflectance data. A General Electric recording spectrophotometer [a] was used in this study. The instrument, based on an optical design by Hardy *(4)*, has been described by Michaelson *(8)*. Gibson *(3)* considered a modified version of this spectrophotometer in his discussion of the basic principles and techniques of spectrophotometry. The reflectance properties of each sample were recorded in the form of a spectrophotometric curve for the spectral region between 400 and 750 mμ. Representative curves with corresponding moisture percentages are shown in Figure 1. The ordinate shows the radiant energy reflected by the sample in a wave length range of 10 mμ as a percentage of the amount reflected by a working standard. This standard of reference, supplied and calibrated by the U. S. National Bureau of Standards, is a sample of selected polished white structural glass having an average reflectance in the 400-700 mμ region of about 90% relative to magnesium oxide *(3)*.[b]

The errors of measurement were considered. The instrument was designed for perpendicular irradiation of a plane sample with a beam of about one-inch diameter and collection of the diffusely reflected energy over a solid angle of almost 180°. The irregular and approximately cylindrical surface of an ear of corn gives rise to certain errors. Some energy from specular reflectance is collected which results in higher values; conversely the loss of diffusely reflected energy from the curved surfaces causes lower recorded values of reflectance. These effects are small and approximately uniform from one sample to another and have been ignored, since precision and relative rather than absolute reflectances are more important in this study.

To determine the precision of reflectance measurements with the recording spectrophotometer, 6 repetitions were made on

[a] Mention of manufacturers and commercial products does not imply endorsement by the Department of Agriculture over others of a similar nature not mentioned.

[b] Information regarding the calibration data can be obtained from the authors.

10 ears of Golden Cross Bantam. For each repetition the ear of corn was removed from the instrument and then replaced in the same position. The standard deviation from the mean was computed for the reflectance sums S(y) of each ear. S(y), as used in this investigation, as well as in a previous report *(5)*, is the sum of reflectances, relative to the working standard mentioned above, for the spectrophotometric curves on corn at those wave lengths used for the 30-selected-ordinate method of tristimulus integration to obtain the tristimulus value Y, based on the C. I. E. standard observer and Illuminant C. The standard deviation covered a range from about 0.4 to 2.2% reflectance with a mean of 1.0%. This range is considered satisfactory for the present study.

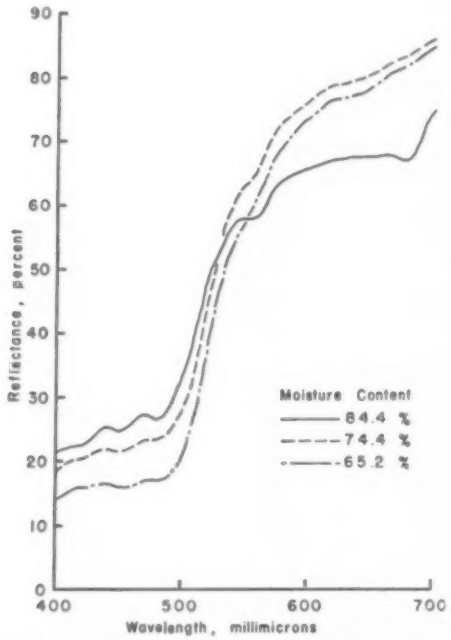

Figure 1. Representative spectrophotometric reflectance curves, relative to the working standard, for samples which had the indicated values of percent moisture.

ANALYSIS OF DATA

In order to study the difference in characteristic shape of the reflectance curves, obtained from the 107 samples of yellow sweet corn differing in maturity, values of percent reflectance relative to the working standard were measured at one wave length from the original spectrophotometric curves. These data were plotted against percent moisture, and a curve was drawn through the set of points. Figure 2 is a composite of curves obtained in the same way for several different wave lengths.

Table 1 shows values of the standard error of estimate for the curves of Figure 2, computed from the experimental reflectance data at each of the wave lengths shown at the top of the table.

The constant wave-length curves of Figure 2 have two distinct features. First, those below 540 mμ show that for decreasing moisture content (more advanced maturity) the percentage of reflected radiant energy also decreases. Secondly, above 540 mμ the reflectance first becomes higher, then lower as the moisture content decreases.

TABLE 1

Values of standard error of estimate, in terms of percent reflectance relative to the working standard, for the constant wave length curves of Figure 2

	Wave lengths (mμ)										
	400	440	480	500	520	540	560	600	640	680	720
Standard error of estimate in percent reflectance	1.3	1.4	1.4	1.8	2.2	2.2	2.1	2.0	2.2	2.5	2.2

APPLICATIONS

The problem of developing a photoelectric method for measuring the maturity of raw yellow sweet corn reduces to the employment of these reflectance features singly or in combination and in a manner which will yield a satisfactory correlation with moisture content. Powers, Gunn, and Jacob *(9)* have outlined the three generally used methods for utilizing reflectance properties. The simplest method consists of a direct measurement of the reflected radiant energy in a suitable region of the spectrum. With reference to Figure 2 and Table 1, it can be seen that for yellow sweet corn the spectral region below 540 mμ may be considered. The advantages of the simplicity of this method may be overbalanced, however, by the need for a more favorable correlation and by the difficulties encountered in maintaining the sensitivity of the measuring system within the necessary tolerance over an extended period of operation. Variations in the size, shape and condition of the ear of corn, as well as variable illumination, may unduly affect the results.

The second method is an extension of the first; that is, the difference in reflectance is measured at two or more regions of the spectrum. The regions employed

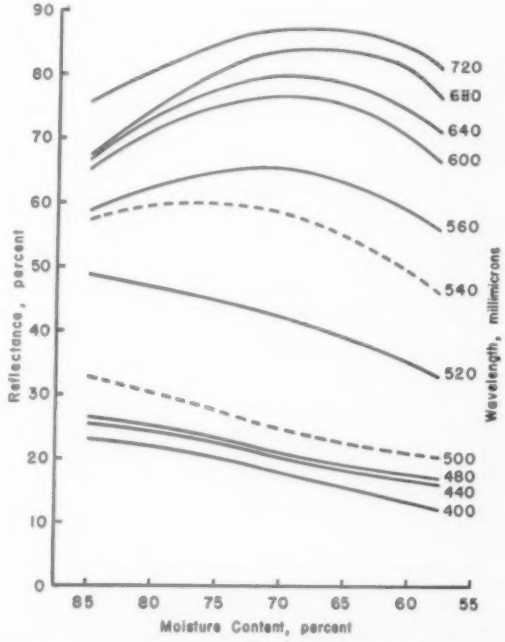

Figure 2. The variation in reflectance values, relative to the working standard, at several wave lengths for a wide range of moisture content.

by Lukens, MacKenzie, and Kunsman *(5, 7)* for obtaining difference values in an experimental photoelectric photometer correspond approximately to the spectral regions of 420-500 and 580-640 mμ. The results reported are a relative measure of the difference of corn reflectance for each sample between these two regions and exhibit the characteristic nonlinear shape which may be expected from an interpretation of Figure 2. In the high-moisture region (less mature corn) the difference in reflectance between the two spectral regions increases markedly with decreasing moisture, but in the lower moisture region this difference is much less sensitive to changes in moisture content. This renders the method unsatisfactory for separating the more mature samples, but it should be useful for distinguishing immature from mature samples.

A variation of the above method, which has been described by the same authors *(5, 7)*, appears to give more uniform sensitivity over the entire maturity range of interest. This consists of subtracting the reflected energy in the spectral region centering around 555 mμ from the sum of those in the 444 and 600 mμ regions of the spectrum. The results are similar to the *a* scale readings of a Hunter color difference meter.[a]

The third method of utilizing the reflectance data is to use the ratio of the reflected energies in selected regions. One distinct advantage of the ratio method over the first two lies in the fact that many factors except the corn reflectances, which affect the numerator will have a proportional effect on the denominator and leave the value of the ratio unchanged.

The ratios of the reflected energies in selected spectral regions can be studied in various combinations in order to determine the ratio which gives the best correlation with moisture differences. Figure 3 shows the results obtained when the ratio of the sum of the reflectances in the 444 and 600 mμ regions, S(x),[c] to that of the 555 mμ region, S(y), is plotted against percent moisture. The regression line is approximately linear and the standard error of estimate of 2.5% moisture is relatively low.

Further examination of Figure 2 reveals the possibility of utilizing ratios of reflectances in other spectral regions. To show some of these, reflectance readings of the spectrophotometric curves at other wave lengths were plotted as shown in Figure 4. Standard error of estimate values, which are shown in the figure, permit the evaluation of their potential usefulness as measures of percent moisture.

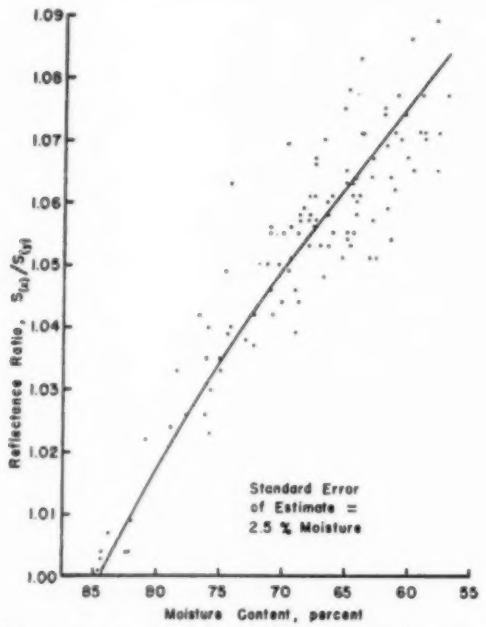

Figure 3. The relation of a reflectance ratio to percent moisture. S(x) refers to the sum of reflectance in the 444 and 600 mμ regions, and S(y) refers to that in the 555 mμ region. See text for definition of S(x) and S(y).

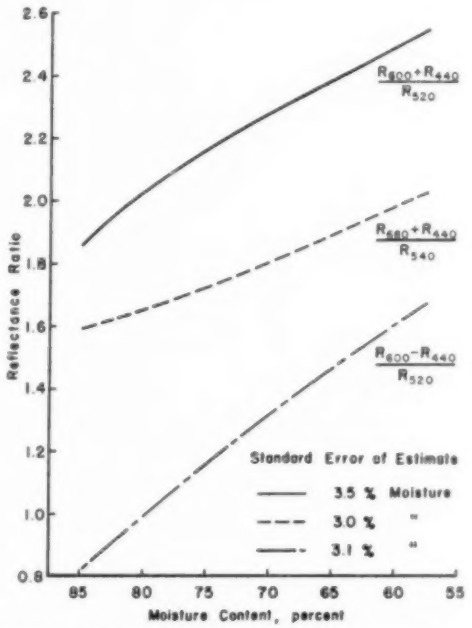

Figure 4. Relations of reflectance ratios to percent moisture obtained from reflectance readings of the spectrophotometric curves at the indicated wave lengths.

INSTRUMENT

A photoelectric photometer has been developed for the purpose of testing the various methods of evaluating the color and maturity of yellow sweet corn *(5, 6, 7)*. The instrument was adapted in this study to measure the ratio of reflected radiant energy passed by a 445 mμ filter plus that passed by a 585 mμ filter to that passed by a 520 mμ filter.[d] Figure 5 shows a schematic diagram of the instrument. A sample of yellow sweet corn is illuminated by two projection lamps mounted at the

[c] S(x) was obtained in the same manner as discussed above for S(y) except that the 30 selected ordinates were those used to obtain the tristimulus value X.

[d] The 445 mμ filter is a combination of Corning Nos. 3389 and 5551 with three layers of Roscoe No. 37 Urban Blue gelatin. The 585 mμ filter is composed of Corning Nos. 9788 and 3304, and the 520 mμ filter combines a Corning No. 5031 and a Wratten No. 58 filter.

lower right and lower left. The radiant energy reflected from the ear of corn is collected by an integrating sphere. Two variable apertures are arranged beneath the sphere to control the amounts of energy passing

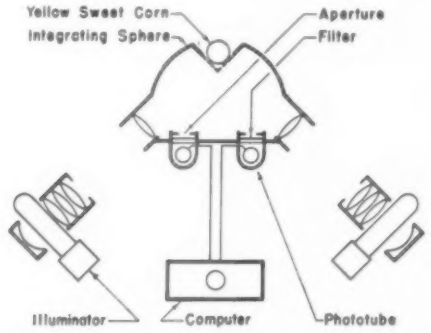

Figure 5. Schematic diagram of an experimental photoelectric photometer adapted to measure the ratio of reflected radiant energy received by two photomultiplier tubes, through filters, from a sample of yellow sweet corn.

through the filters to the two 931-A photomultiplier tubes. One tube receives energy from two regions of the spectrum coresponding to the 445 and 585 mμ filters. The other photomultiplier is affected only by energy which passes the 520 mμ filter. The ratio of the two photomultiplier output currents is computed by an electronic circuit operating on an inverse feedback principle. This computation is based on the fact that the value of a ratio is equal to the numerator after both parts of the fraction have been multiplied by a factor that causes the denominator to become unity. The computing circuit operates to change the voltage applied to one of the photomultipliers so that its photocurrent remains constant under varying amounts of incident energy. With the same voltage applied to the second photomultiplier, its photocurrent then becomes a measure of the incident radiant energy relative to that incident upon the first tube. This value is read directly from a meter and can be calibrated with the moisture content of the sample.

Some experimental results obtained with the photoelectric photometer are shown plotted against moisture content in Figure 6. The relationship is approximately linear, an indication of the uniformity of sensitivity over the entire maturity range of interest, and the standard error of estimate is only 2.0% moisture. These data are in good agreement with the results expected from an examination of the spectrophotometric data shown in Figure 2 and indicate that the measurement of the ratio of reflectances from yellow sweet corn may have practical usefulness as an objective method for judging maturity. The photoelectric reflectance method is not considered to be as accurate an index of maturity as such generally used laboratory methods as vacuum oven moisture, alcohol insoluble solids, refractive index, crude starch and Brown-Duvel moisture *(1)*. It is, however, the only known method which can satisfy the requirements of a fast, nondestructive measurement on individual ears of yellow sweet corn. Furthermore, the method appears to be suitable and accurate enough to be used for automatically sorting this product for processing.

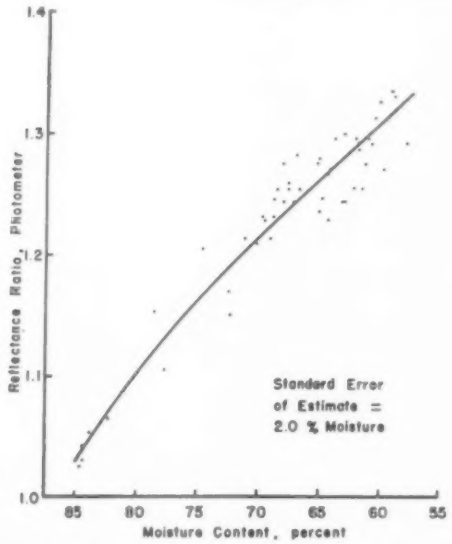

Figure 6. Some results obtained on raw Golden Cross T Strain yellow sweet corn with the experimental photometer adapted to measure reflectance ratios.

Acknowledgments

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Organic Acids in Brewed Coffee[a]

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Using partition chromatography, the organic acids of five coffee extracts were determined. The predominant acid was found to be chlorogenic; the least in evidence was acetic acid. Caffeic, pyruvic, oxalic, malic, citric and tartaric acids were present. The role of chlorogenic acid in the flavor of coffee warrants further investigation.

The United States is first among the coffee consuming nations of the world. Brewed coffee contains caffeine, amino acids, sugars, caramel, trigonelline, caffeic acid, chlorogenic acid and its isomers, mineral matter, and various organic materials besides some coffee oil carried along with the hot water.

The composition of coffee beans varies markedly according to variety and locality. The soluble solids of roasted coffee beans grown in India might be as low as 26.0 or as high as 33.0%, Subrahmanyan *et al. (12)*. An average of 29.0-30.2% water soluble solids was reported for Coffea robusta and 26.3-30.0% for C. arabica, Narayanaiyer and Ramachandran *(10)*.

The small quantities of organic acids give to the coffee brew its essential acidity. The actual acidities of some East Indian coffees vary from 0.013 to 0.033%, Jacobs *(6)*. The organic acids in coffee brew have not yet been established. Bernheimer *(3)*, and Jaeckle *(7)* identified acetic acid in roasted coffee. Later, Arbenz *(1)*, reported the presence of 0.08% oxalic acid in roasted coffee. Widmark and Ahldin *(15)* found 0.04% oxalic acid in roasted coffee by Holmberg's method. More recently, Moores *et al. (9)* have found chlorogenic acid at a concentration of 4.58% in roasted coffee. In the literature, considerable attention has been devoted to chlorogenic acid, one of the major soluble constituents of coffee. Therefore, it appears that a thorough study of the organic acids of coffee brew would contribute to the knowledge of the chemical composition of coffee.

The partition chromatographic method for the analysis of organic acids by Bulen *et al. (4)* seems particularly adaptable for a study of this kind.

EXPERIMENTAL

Roasted coffee. This work was carried out on a commercial blend of coffee and was part of a single lot obtained by The Coffee Brewing Institute, Inc., for research on brewed coffee. To minimize any chemical changes that might take place in the ground roasted vacuum packed coffee, one-pound samples were stored at —20° C. as suggested by Wyler *(16)*.

Preparation of dried water-soluble coffee extracts. Coffee extracts were prepared by the vacuum method. A brief description of this method is given herewith. One pound of roasted coffee was used in preparing 2 gallons of coffee brew. The lower bowl of a Silex coffee maker was filled with water, placed over a hot plate and brought to the boiling point. The filter was adjusted on the upper bowl and the correct amount of coffee was placed in it. When the water reached the boiling point, the upper bowl was fitted in position on the lower one, twisting slightly to make an airtight seal. Then heat was reduced and the water was allowed to rise into the upper bowl. The mixture in the upper bowl was stirred for 2 minutes and then removed from heat. Coffee brew was allowed to return to the lower bowl and the upper bowl was removed.

The residual roasted coffee in the upper bowl was extracted further for 4 consecutive times with the same volume of water to insure maximum soluble solids extraction. The volumes of the 5 serial coffee extracts were recorded. Each extract was divided into two equal volumes, one was adjusted to pH 8.0 by the addition of 0.1 NaOH solution while the other to pH 2.0 by adding 0.1 N HCl solution.

Each portion was concentrated to a volume of 100 ml. by heating to 40° C. under vacuum. These concentrates were freeze dried and the resulting powdered soluble solids stored in a desiccator.

Chromatographic separation. The chromatographic method using a silicic acid column with butanol-chloroform solvents for developing agents as described by Bulen *et al. (4)* was employed for the determination of the organic acids. The samples were acidified to pH 1.0 to insure that the organic acids were present in the non-ionized form as recommended by Rice and Pederson *(11)*. Through the use of a fraction collector devised by Varner and Bulen *(14)*, 3.3 ml. fractions were collected.

RESULTS AND DISCUSSION

Soluble solids. Two series of 5 coffee extractions were carried out, using distilled water and tap water to get maximum soluble solids. The pH values of these extractions were measured with a Beckman pH meter model G. Results, summarized in Table 1, show that

TABLE 1
pH values of coffee extracts

	Distilled water	Tap water
	6.44	9.63
Extract (1)	5.04	5.05
Extract (2)	5.38	5.38
Extract (3)	5.70	5.78
Extract (4)	5.64	6.11
Extract (5)	5.95	6.35

the pH of the first and second extracts were not affected by the alkaline tap water. These data agree with that reported by Ishikawa and Arkawa *(5)* who found that the pH of Brazilian coffee prepared by boiling 2 g. in 200 ml. water was 5.45.

Two hundred and twenty-seven grams of roasted coffee was extracted with 3785 ml. of distilled water and yielded 3160 ml. of coffee brew. The residue was extracted again with the same volume of water. This gave 3400 ml. The resulting 3rd, 4th, and 5th extracts were 3420, 3500, and 3630 ml., respectively. The amount of soluble solids is given in Table 2.

Whereas total water soluble solids in the 5 extracts was 31.10% of the roasted coffee, the first extract contained almost three-fourths of the water soluble solids.

[a] Presented before the Fifteenth Annual Meeting of the Institute of Food Technologists, Columbus, Ohio, June 13, 1955.

TABLE 2
Soluble solids in coffee extracts

Extract number	Soluble solids Grams/100 grams roasted coffee
I	22.48
II	3.72
III	2.33
IV	1.68
V	0.89
Total	31.10

Ukers *(13)* found that the water soluble solids in roasted beans of different localities ranged from 30.30 to 31.27%.

Recovery of organic acids on a silicic acid column. Five milligrams of each of the following acids, acetic, pyruvic, caffeic, chlorogenic, glutaric, fumaric, formic, lactic, succinic, α-ketoglutaric, oxalic, malic, citric, tartaric and quinic acids was chromatographed separately to determine the peak effluent volume of each and the efficiency of recovery. Figure 1 shows the results for

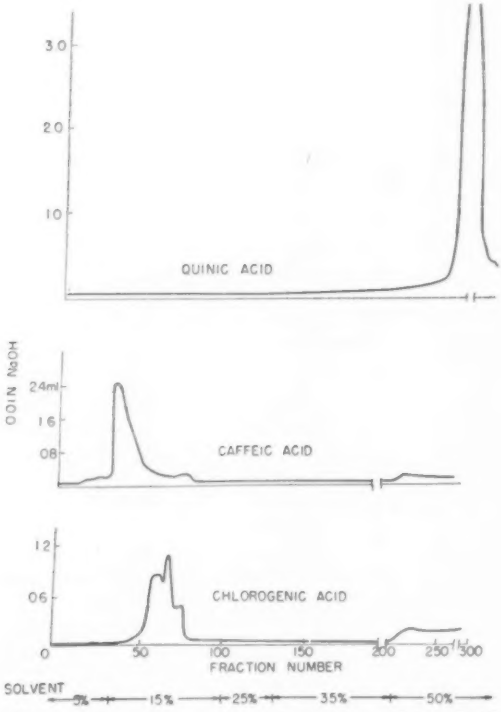


Figure 1. Peak effluent volume for quinic, caffeic and chlorogenic acids.

caffeic, chlorogenic, and quinic acids. Following these determinations, a solution that contained all these acids was prepared and chromatographed. Results, Figure 2, were similar to those from the standard solutions chromatographed separately and indicated that good separation of the acids was obtained from this solution. The recovery data presented in Table 3 indicated that the efficiency of the column was 92 to 104%.

After the preliminary analysis had been completed, the coffee extracts were chromatographed. Figures 3 and 4 are typical of the chromatographs of coffee extracts. Results of the chromatographic analysis of these 5 serial coffee extracts which had been made basic are reported in Tables 4 and 5.

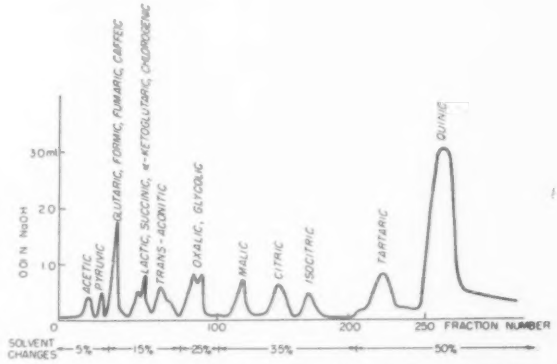


Figure 2. Chromatographic separation of standard mixture of organic acids.

From Tables 4 and 5, it is quite obvious that coffee extracts contain acetic, pyruvic, caffeic, chlorogenic, oxalic, malic, citric and tartaric acids. Chlorogenic acid was the predominant acid and acetic acid was in relatively low concentrations. Only a trace of formic acid was present in coffee extract No. 1. None of the other coffee extracts was found to contain measurable amounts of formic acid.

Due to the lack of authentic samples of chlorogenic acid isomers, it was impossible to determine their percentage in coffee extracts by partition chromatography. Barnes *et al. (2)* found that green coffee contained 0.75% crude isochlorogenic acids which had different rotatory powers and different neutralization equivalents.

TABLE 3
Calibration of the silicic acid column

Organic acid	Percentage I	Recovery II
Acetic	95	103
Pyruvic	104	99
Glutaric	100	98
Fumaric	97	95
Formic	95	103
Lactic	96	93
Succinic	93	91
α-Ketoglutaric	105	93
Trans-aconitic	88	90
Oxalic	95	98
Glycolic	98	98
Malic	103	99
Citric	99	93
Tartaric	95	102
Chlorogenic	92	95
Caffeic	98	104
Quinic	107	103

The total chlorogenic acid recovered from the 5 coffee extracts amounts to 4.30%. This is in agreement with the value of 4.58 reported by Moores *et al. (9)* who used a method based on the adsorption of chlorogenic acid at 324 mμ before and after precipitation of the

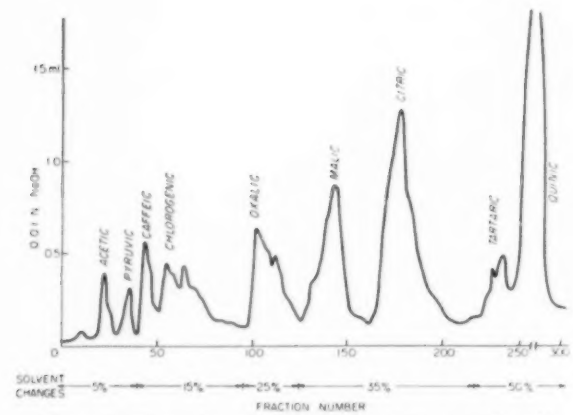


Figure 3. Chromatographic separation of the organic acids in the acidified coffee brew.

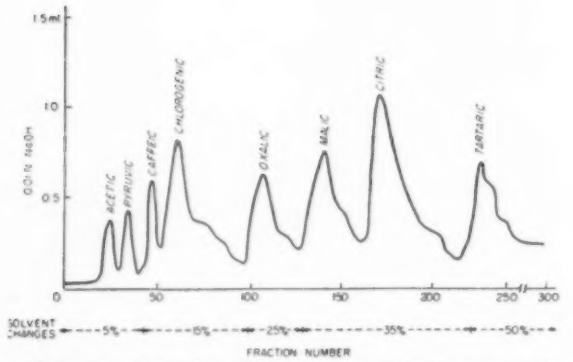


Figure 4. Chromatographic separation of the organic acids in the basic coffee brew.

TABLE 4
Chromatographic analysis of organic acids in coffee extracts as percent by weight of the extract

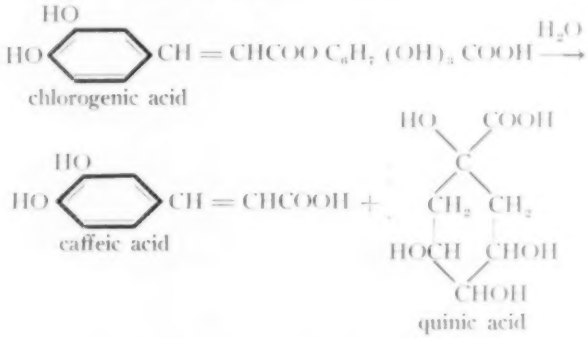
Organic acid	Coffee extract number				
	I	II	III	IV	V
Acetic	0.127	0.130	0.101	0.076	0.093
Pyruvic	0.194	0.2010	0.125	0.093	0.020
Caffeic	1.70	1.311	1.60	0.980	0.863
Chlorogenic	16.81	9.54	3.43	3.28	3.35
Oxalic	0.755	0.485	0.322	0.245	0.210
Malic	1.730	1.085	0.863	0.513	0.588
Citric	1.850	1.581	0.551	0.404	0.454
Tartaric	1.376	1.284	0.998	0.784	0.633

TABLE 5
Chromatographic analysis of organic acids in coffee extracts as percent by weight of roasted coffee beans

Organic acid	Coffee extract number					
	I	II	III	IV	V	Total
Acetic	0.0285	0.0048	0.0024	0.0013	0.0008	0.0378
Pyruvic	0.0436	0.0075	0.0029	0.0016	0.0002	0.0558
Caffeic	0.381	0.049	0.037	0.017	0.008	0.492
Chlorogenic	3.78	0.355	0.0799	0.0551	0.0299	4.30
Oxalic	0.170	0.018	0.008	0.004	0.002	0.202
Malic	0.389	0.040	0.020	0.009	0.005	0.463
Citric	0.416	0.059	0.013	0.007	0.004	0.499
Tartaric	0.309	0.048	0.023	0.013	0.006	0.399
Total	5.52	0.58	0.186	0.107	0.055	6.45

chlorogenic acid in roasted coffee with basic lead acetate. These workers investigated and modified the Slotta and Neisser iodometric oxidation method for chlorogenic acid in green and roasted coffee.

The large peak that appears in Figure 3 presented a problem. The peak appears only in the case of the acidified coffee extracts and does not show up in the basic coffee extracts, Figure 4. At the same time the values for caffeic acid were higher in the acidified coffee extracts than in the basic extracts. It is well known that chlorogenic acid is the condensation product of one molecule of caffeic acid and one molecule of quinic acid.



In the presence of a strong acid, chlorogenic acid is hydrolyzed to one molecule of caffeic acid and a molecule of quinic acid, Karrer *(8)*. A pure sample of quinic acid was chromatographed (Figure 1), and the eluate was collected; the peak of this authentic sample acid matched the ones found in the acidified extracts. The excess in the caffeic acid values in the acidic extracts is equivalent to the amounts of quinic acid values chromatographed. To be sure that this assumption was correct, a comparison was made between the percentage recovery of chlorogenic acid in both the acidic and basic coffee extracts No. 1 and 2 using partition chromatography, the modified Slotta and Neisser iodometric oxidation method, and the ultraviolet spectrophotometric method *(9)*. From Table 6, it is quite clear that the

TABLE 6
Determination of chlorogenic acid by partition chromatography, ultraviolet method and iodometric method

Extract no.	Percentage of chlorogenic acid found by		
	Chromatographic method	Ultraviolet method	Iodometric oxidation method
Chlorogenic acid	103.00	97.00	99.00
Extract 1 acidic	10.047	9.800	10.046
Extract 1 basic	16.811	16.450	16.801
Extract 2 acidic	8.087	7.887	8.094
Extract 2 basic	9.535	9.335	9.295

chromatographic determination of chlorogenic acid is comparable to the other two methods.

In relation to total acids recovered, chlorogenic acid accounted for an average of 66.7%, citric acid for 7.7%, malic acid for 7.2% and tartaric acid for 6.2%, Table 7. From the data in Tables 5 and 7, it is quite obvious that the percentage of the organic acids in extract 2 is approximately the same as that found in extract 1.

When this study was started the assumption was made that during lyophilization of the extracts no acids would be lost from the extracts made basic and no bases would be lost from the extracts made acid. Hence the acidic constituents of the basic extracts were studied for the most part. However, to check methods on non-volatile acids of both treatments acids were determined on acidified extract I. Good agreement was obtained except as noted for chlorogenic, caffeic, and quinic acids. The imprtance of the hydrolysis of chlorogenic acid in the changes of coffee flavor remains to be worked out. Since the chlorogenic acid is acid labile and since it accounts for two-thirds of all acidic constituents in coffee brew, or approximately one-sixth of the total soluble solids, it would be well to investigate the role of chlorogenic acid in the flavor of coffee brews which have been boiled or heated over prolonged periods of time or prepared by extraction at higher temperatures.

TABLE 7

Percentage of organic acids in coffee extracts in relation to total acids recovered

Organic acid	Coffee extract number					
	I	II	III	IV	V	Total
Acetic	.52	00.83	1.29	1.45	1.21	00.59
Pyruvic	.79	1.29	1.56	.36	1.49	00.87
Caffeic	6.91	8.40	20.00	13.9	15.4	7.63
Chlorogenic	68.5	61.7	42.9	54.1	51.4	66.69
Oxalic	3.08	3.10	4.03	3.44	3.82	3.12
Malic	7.05	6.96	10.8	9.40	8.02	7.19
Citric	7.54	10.12	6.88	7.23	6.34	7.73
Tartaric	5.61	8.23	12.5	10.1	12.3	6.19

SUMMARY

The organic acids of aqueous coffee extracts were determined by partition chromatography. The series of five coffee extracts analyzed contained acetic, pyruvic, caffeic, chlorogenic, oxalic, malic, citric and tartaric acids. The predominant acid present is chlorogenic and the one present in low concentration is acetic acid. Traces of formic acid were found in the first coffee extract.

Acknowledgment

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Effects of Different Methods of Blanching On the Quality of Home Frozen Spinach[a]

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A number of studies on the blanching of vegetables have been published; however, some problems remain to be solved. The quality of vegetables preserved by freezing is affected by the amount and kind of blanching *(1, 2, 3, 4, 6, 7)*. Although blanching in boiling water is widely used, interest has also been shown in using the pressure saucepan and the steam jacket cooker for blanching. In the study reported herein, direct comparisons were made of the palatability and nutritive value of two varieties of spinach over a three-year period. Three household methods of blanching duplicate samples were used: (a) boiling water; (b) pressure saucepan at atmospheric pressure; and (c) steam jacket cooker, with two different blanching times for each.

EXPERIMENTAL PROCEDURE

Varieties harvested. Nobel and Bloomsdale Longstanding spinach were grown and harvested under the supervision of the Department of Horticulture. The spinach was brought to the food research laboratory, as early in the morning as possible after picking, where it was prepared for freezing.

Preparation for blanching. The spinach was washed quickly by holding one leaf at a time under cold running water; then the excess moisture was removed by patting gently with several thicknesses of cheesecloth. Stems were pinched off to within approximately ¼-inch of the leaf. Substandard portions were removed. One-hundred gram samples were weighed into 17-inch cheesecloth squares. Fresh samples were refrigerated until used for palatability and/or ascorbic acid testing. The remainder was divided into 40 lots to be blanched by the 3 methods.

Procedure for blanching. The corners of the cheesecloth square were gathered together around the 100-g. sample to form a loosely fitting bag. In blanching, the corners of the bag were caught under the lid of the kettle in such a way that the spinach did not float out. A 4-quart kettle was used for each method. Details of the procedures are given in Table 1.

Treatment after blanching. Immediately after blanching samples were cooled for 2 minutes by lowering them into a pan of cold water, into which more cold water was running. During the entire cooling process the bag was open so that the water reached the center as well as the outside of the sample. Samples were then drained and excess moisture removed by gently patting with several thicknesses of cheesecloth. Next the spinach was packaged in Shellene bags, the air pressed from the bags, and the tops twisted and goose necked before fastening securely with plastic covered wire ties. Duplicate samples were packaged in pint cartons for freezing, the cartons labeled, and put into the refrigerator until all processing was finished for the day. The cartons were then placed on freezing plates, at approximately −10° F. until frozen. After 24 hours they were moved from the plates and stored at 0° F.

Procedure for testing. After blanching, freezing, and storing, the spinach was cooked for testing. Tests and determinations were made immediately after harvesting, after 24 hours in the freezer, and after 1, 3, and 6 months' freezer storage. The frozen spinach was partially defrosted at room temperature for approximately 1 hour, then plunged into boiling water (salted, if used for palatability) and the mass pulled apart with two forks before placing the lid on the kettle. The mass was returned quickly to the boil and boiled gently 4 minutes.

Methods of testing. Palatability tests and ascorbic acid determinations served as indices of quality and nutritive value of the spinach, and the data obtained were subjected to analysis of variance. When there were significant differences in the main effects and interactions between blanching methods and blanching time, blanching methods and storage, blanching methods and year, blanching time and storage, blanching time and year, and/or storage time and year, two way tables of means were analyzed by least significant differences.

TABLE 1
Blanching procedures used for spinach

Variety [1]	Blanch method [2]	Amount of water used in kettle	Blanching time [3]	Cooled in running water
		cups	*min.*	*min.*
NS	BW	8	2	2
			2.5	2
	PSP [4]	1.75	3	2
			4	2
	SJC	8 (inset)	2	2
		4 (jacket)	2.5	2
BLS	BW	8	2	2
			2.5	2
	PSP [4]	1.75	3	2
			4	2
	SJC	8 (inset)	2	2
		4 (jacket)	2.5	2

[1] NS—Nobel spinach; BLS—Bloomsdale Longstanding spinach.
[2] BW—Boiling water; PSP—Pressure saucepan; SJC—Steam jacket cooker.
[3] After water returned to boil.
[4] Atmospheric pressure.

A panel of qualified judges scored the spinach for aroma, appearance, flavor, and texture, on a scale ranging from −5 to +5, with 0 as standard. Each judge also indicated whether or not he considered the spinach an acceptable product. A modification of the Loeffler Ponting method *(5)* was used for the ascorbic acid analysis.

RESULTS AND DISCUSSION

All three blanching methods gave satisfactory results. In general, blanching in boiling water was as easy and about as desirable as any method tried. The 4-quart pressure saucepan was inconvenient to use since the capacity was limited. The steam jacket cooker had no advantage over the other two methods used. In the study reported here, the water, regardless of method, returned to the boil in a matter of seconds each time. However, if larger samples had been used, more difference might have been detected.

Blanching methods affected palatability scores (Tables 2 and 3) differently in different years; that is, there was a blanching method by year interaction. With both varieties the blanching effects were dependent upon year and time of storage. Time of blanching did not affect appearance, aroma, flavor, or texture of either variety. Usually, however, the time of blanching did

[a] Contribution No. 190, Department of Home Economics, and Contribution No. 254, Department of Horticulture, Kansas Agricultural Experiment Station, Manhattan.

make a difference in ascorbic acid retention, the shorter time generally producing higher readings than the longer. There were some exceptions to this statement associated with year and blanching method. However, the exceptions were not significant reversals of the direction noted but were simply reductions to non-significance or were "apparent"—though non-significant reversals.

Nobel Spinach

Average palatability scores used in determining quality of Nobel spinach are shown in Table 2.

Appearance. Year effects were quit erratic for the different storage times and different blanching methods. In 1952 there was less decrease, definitely, in the appearance score with increased storage when the pressure saucepan was used for blanching. Spinach blanched in the steam jacket cooker tended to result in the poorest appearing product, immediately after freezing, and, in general, appearance scores decreased with added storage.

Aroma. Storage effects on aroma existed, were generally reflected by decreases in average score, but there were several exceptions. No significant blanching difference within a year and period of storage were noted except in 1954 with the 0 storage and with that stored 6 months. The effects of storage were conditioned by both year and the blanching method employed.

Flavor. The comparison of flavor scores changed from year to year and with storage. In 1954, flavor scores for spinach blanched in the pressure saucepan were significantly lower than those blanched in boiling water at every storage; they were significantly below those blanched in the steam jacket cooker 3 times out of 5. There was no storage effect on flavor before 1 month and usually none until 3 months of storage.

Texture. Storage effects seemed quite erratic when considered alone. In 1953, when spinach was blanched in boiling water, the texture scores increased significantly between 1 and 3 months of storage, and then dropped significantly again after 3 more months of storage. The only important blanching effect on texture was found in the 1954 season. Spinach blanched in the pressure saucepan tended to have a lower score than that blanched in boiling water, especially after 3

TABLE 2

Average palatability scores for cooked Nobel spinach (possible range, −5.0 to +5.0)

Storage time	Blanch method[1]	Palatability scores											
		Appearance			Aroma			Flavor			Texture		
		1952	1953	1954	1952	1953	1954	1952	1953	1954	1952	1953	1954
0	BW	1.8	0.5	1.3	1.0	0.5	1.3	0.5	−0.3	1.0	1.0	0.0	1.0
	PSP	0.5	1.0	1.8	1.0	0.5	0.0	0.8	−0.3	−0.3	0.3	0.0	0.3
	SJC	0.8	0.5	−0.5	0.0	0.3	−0.5	0.5	−0.3	−1.5	1.0	0.0	−0.5
24 hours	BW	0.8	0.5	1.0	0.0	0.8	0.0	−0.3	−0.3	1.0	0.5	−0.5	0.0
	PSP	0.0	1.0	1.0	0.8	0.3	0.0	0.3	−0.5	−1.0	0.3	−0.3	−0.3
	SJC	−0.5	1.0	−0.5	0.0	0.5	0.5	−0.5	−0.5	−0.8	−0.5	−0.5	−0.5
1 month	BW	0.8	1.0	1.0	0.0	0.5	0.0	0.0	0.0	−0.3	−0.3	−1.0	0.0
	PSP	0.3	0.0	0.0	0.0	0.3	0.3	0.0	−0.3	−2.3	−1.0	−0.8	−0.5
	SJC	0.8	0.5	0.3	0.3	0.5	−0.5	−0.3	−0.5	−1.8	−0.5	−0.5	−0.5
3 months	BW	−0.3	0.0	0.0	1.0	0.0	0.0	0.0	−0.8	−0.5	−0.3	0.3	0.0
	PSP	−0.5	−0.3	−0.8	0.3	0.0	−0.3	−0.8	−1.3	−2.5	−0.5	0.0	−1.0
	SJC	0.5	−0.3	−0.8	1.0	0.0	−0.3	−0.8	−1.0	−1.3	0.5	−0.3	−1.0
6 months	BW	−0.3	−0.3	−1.0	0.0	0.0	−0.5	−0.5	−2.0	−1.5	−0.8	−0.8	−1.0
	PSP	−0.3	−0.5	−1.8	0.0	−0.5	−1.3	−0.3	−1.8	−3.0	−0.5	−1.0	−2.3
	SJC	0.0	−1.0	−2.0	0.0	−0.8	0.0	0.0	−1.8	−1.0	−0.8	−1.0	−1.0

[1] BW—Boiling water; PSP—Pressure saucepan; SJC—Steam jacket cooker.

TABLE 3

Average palatability scores for cooked Bloomsdale Longstanding spinach (possible range, −5.0 to +5.0)

Storage time	Blanch method[1]	Palatability scores											
		Appearance			Aroma			Flavor			Texture		
		1952	1953	1954	1952	1953	1954	1952	1953	1954	1952	1953	1954
0	BW	2.0	1.5	1.0	1.8	1.0	0.3	2.3	1.3	−0.3	1.0	0.0	0.5
	PSP	1.5	1.5	1.8	1.5	1.0	0.0	1.5	0.8	−0.5	0.5	0.0	0.0
	SJC	2.0	1.5	−0.8	1.8	0.8	−0.3	0.5	0.8	−1.0	0.8	0.0	−1.0
24 hours	BW	1.8	1.5	1.0	1.0	1.3	0.0	1.8	0.3	−1.3	0.0	−0.3	0.0
	PSP	0.5	1.0	0.0	1.0	1.3	0.0	1.0	0.5	−0.8	0.0	0.0	0.0
	SJC	1.3	1.0	0.0	1.0	0.5	−0.3	1.5	0.5	−1.8	0.0	0.0	−0.5
1 month	BW	1.0	0.8	0.0	0.8	0.8	0.3	0.8	0.0	−0.8	−0.5	−0.3	−0.3
	PSP	0.3	0.8	0.8	0.0	0.2	0.0	0.3	0.0	−1.0	−0.3	−0.8	−0.8
	SJC	1.0	0.0	−0.2	0.3	1.0	−0.2	0.5	0.0	−1.3	−0.3	−0.5	−0.8
3 months	BW	1.0	0.8	0.0	1.0	0.0	0.0	0.8	−0.5	−0.8	0.0	−0.5	−1.0
	PSP	1.3	0.3	−1.0	1.0	0.0	0.0	0.5	−0.8	−1.0	0.0	−0.3	−0.3
	SJC	1.3	1.0	−0.8	0.8	0.0	0.0	1.5	−0.3	−1.3	0.5	0.0	−0.8
6 months	BW	0.0	−0.3	−0.3	0.3	−0.3	−0.8	0.5	−0.3	−2.3	0.0	−0.5	−1.0
	PSP	−0.3	0.0	−2.0	0.0	0.0	−1.0	0.5	−0.5	−2.8	0.0	−0.8	−2.0
	SJC	0.3	−0.5	−0.8	0.3	−0.5	−0.5	1.0	−1.0	−2.0	0.3	−1.0	−1.3

[1] BW—Boiling water; PSP—Pressure saucepan; SJC—Steam jacket cooker.

months or more of storage. Storage effects were highly dependent upon year and to some extent upon blanching method. In 1954, there was a significant drop in texture score within 24 hours, a 3-month period of no change, and then another significant change during the next 3 months of storage. Four blanching-year combinations out of 9 showed no significant change during the last 3 months of storage.

Ascorbic acid retention. Storage of spinach sharply reduced the ascorbic acid, even in 24 hours (Table 4). Spinach blanched in the pressure saucepan maintained the highest ascorbic acid of the 3 methods, excepting after 6 months when retention was about like that blanched in boiling water.

Bloomsdale Longstanding Spinach

The average palatability scores used in determining the quality of Bloomsdale Longstanding spinach are shown in Table 3.

Appearance. Blanching effects on appearance depended on the year. In 1952 spinach blanched in boiling water or in the steam jacket cooker was much the same but produced higher appearance scores than that blanched in the pressure saucepan. In 1953 there were no appreciable blanching method differences. In 1954 spinach blanched in boiling water was superior to that blanched by the other two methods. The effects of each of the blanching methods changed significantly from year to year. Additional storage decreased the appearance score significantly, excepting the period from 1 to 3 months of storage.

Aroma. In general the aroma of spinach blanched in boiling water was superior to that blanched in either the pressure saucepan or steam jacket cooker. The effect of storage depended on the year and was quite erratic from one storage period to another. For example, aroma scores increased between 1 and 3 months of storage in 1952. In 1953 and 1954 aroma scores decreased with storage or stayed the same.

Flavor. The flavor of spinach blanched in boiling water was superior to that blanched by either of the other methods. Storage effects on flavor depended on the year, but flavor generally decreased with storage. In 1952 there was a significant drop in flavor score at the end of one month's storage but no significant change thereafter. In the other two years flavor scores dropped significantly after 24 hours' storage, but also dropped significantly thereafter.

Texture. The effects of blanching upon texture depended on the year and storage, while the storage effect depended on blanching method and year. In 1952, texture scores dropped significantly in 24 hours and did not change significantly thereafter. However, in 1953, when spinach was blanched in boiling water, no significant change of texture was observed after additional storage. With the other blanching methods, texture scores dropped significantly with additional storage in each of the 3 years.

Ascorbic acid retention. After 3 to 6 months' storage the data (Table 4) indicated that none of the blanching methods was better than another for ascorbic acid retention. Ascorbic acid decreased with storage, most rapidly with that blanched in the steam jacket cooker and pressure saucepan. However, blanching in boiling water probably reduced the initial ascorbic acid content more than did blanching in the steam jacket cooker.

SUMMARY

Three household methods of blanching—in boiling water, in a pressure saucepan at atmospheric pressure, and in a steam jacket cooker—were used with Nobel and Bloomsdale Longstanding spinach. Two blanching times were used with each method. Comparisons, over a 3-year period, were made of the palatability and nutritive value of the products of each method after freezing.

Blanching effects were dependent upon year and time of storage and were inclined to be erratic. No one method of blanching was consistently superior when both palatability and nutritive value of the frozen spinach were considered. Blanching time did not affect the palatability of the spinach significantly. However,

TABLE 4

Average percentage ascorbic acid retention of cooked spinach (raw weight basis)

Variety[1]	Blanch time	Blanch method[2]	After blanching and cooling			After frozen storage for											
						24 hr.			1 mo.			3 mo.			6 mo.		
			1952	1953	1954	1952	1953	1954	1952	1953	1954	1952	1953	1954	1952	1953	1954
	min.																
NS	2	BW	73.6	59.5	43.5	55.4	49.0	42.8	60.7	49.2	49.2	49.6	35.3	36.8	46.7	38.3	30.6
	2.5	BW	52.4	51.6	37.7	48.1	53.2	36.5	43.1	39.6	38.7	27.9	28.8	30.7	33.1	27.6	27.8
	3	PSP	94.6	63.3	59.3	80.5	58.5	54.0	58.6	52.6	47.8	69.8	36.8	38.7	45.2	37.8	20.2
	4	PSP	65.5	65.5	49.1	63.3	54.2	52.2	57.9	46.9	47.0	50.2	37.8	39.5	44.4	36.6	33.6
	2	SJC	60.6	65.4	64.4	43.0	52.7	52.6	39.5	35.5	38.0	32.5	32.1	38.9	20.2	26.4	22.9
	2.5	SJC	47.0	61.7	59.3	35.6	51.5	51.2	39.9	29.7	45.6	35.1	43.1	38.1	18.0	30.0	17.8
BLS	2	BW	39.0	45.0	37.9	31.7	44.4	39.7	32.2	44.3	40.1	28.3	26.1	29.1	21.8	26.1	20.7
	2.5	BW	32.7	41.8	31.6	29.7	42.4	38.7	25.0	40.1	34.3	17.5	34.0	25.2	16.6	29.8	23.8
	3	PSP	37.8	45.9	39.9	36.3	44.7	43.5	32.3	37.4	30.5	18.2	32.2	22.0	20.7	33.8	26.7
	4	PSP	39.7	42.3	31.2	36.9	42.4	37.6	24.7	38.0	27.7	29.3	32.9	25.1	20.3	23.7	23.0
	2	SJC	41.1	48.4	41.7	29.8	41.1	34.7	30.3	31.7	31.0	30.2	30.7	31.3	21.4	30.8	29.3
	2.5	SJC	37.4	42.4	40.4	35.8	35.9	29.8	32.9	29.3	31.1	25.2	29.2	23.5	21.1	22.9	16.6

[1] NS—Nobel spinach; BLS—Bloomsdale Longstanding spinach.
[2] BW—Boiling water; PSP—Pressure saucepan; SJC—Steam jacket cooker.

the shorter blanching time usually produced greater ascorbic acid retention than did the longer. Since there was no apparent advantage for any one method, blanching spinach in boiling water for 2 minutes is recommended.

Acknowledgments

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Duration of Sensitivity in Trio Taste Testing

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With beer as the product and duo-trio as the method of testing it is shown that five tests can be run in a single session without encountering loss of sensitivity. In fact, there were more correct responses, proportionately, using five tests per session than when only two were administered.

Many administrators of flavor evaluation laboratories are faced with the problem of determining the maximum practical utilization of subjects trained for difference tests. From the viewpoint of economy, it often is necessary to obtain the greatest amount of data from the fewest possible subjects in the shortest possible time, and, at the same time, to maintain desired sensitivity.

Although many physical and psychological considerations affect sensitivity, this study is concerned only with the effect of multiple testing within a single test session. Therefore, we need not be concerned with sensitivity in an absolute sense, but only with its variation as a function of the position of the given test within a series.

The number of tests that a subject can take in one session has been the source of much debate and varied opinion. Peryam *(3)* reported that in duo-trio testing of milk their laboratory gave "two or three tests at one time, but we know we cannot give as many as five." Laue, Zlobik and Ishler *(2)* found a significant decline in sensitivity on repeated tests of maple syrup. This type of finding seems to have been generally concurred in by most practical workers.

Brandt and Hutchison *(1)*, however, reported that 4 tests per session were practical on several beverage products. Pfaffman, Schlosberg, and Cornsweet *(4)* found no loss of sensitivity over an entire hour of testing involving as many as 18 triangular comparisons. This held true for several different products. However, the practical significance of these results may be limited because of the fact that the panel used was not highly trained from the point of view of general experience in taste testing, nor had it specialized on either a particular product or a single method. For these reasons, although the results may well apply for laboratories with a similar operational background, they should be very cautiously applied to the industrial laboratory where the general level of sensitivity is at a maximum because of product and method specialization and long experience with daily testing. Despite this qualification the Pfaffman study has served a notable purpose in shaking certain long held but generally unsubstantiated beliefs on sensitivity duration.

The number of tests per subject is reflected directly in the cost of testing because the total number of tests needed to handle any particular set of operations is more or less fixed. Limiting judgments to one or two per subject may be a waste of time and money. But how many tests can you give to each subject in a single session?

It would seem reasonable to assume that at some point in a series of successive tests by an individual subject sensitivity will begin to decline. In a strict physiological sense this point may be immediately after the first sample for there is evidence that neurological fatigue begins at the moment of first excitation. It is possible that the taste apparatus needs some stimulation to reach maximum sensitivity so that the second might be the optimum test from a physical viewpoint; however it is likely that the effect of sensory fatigue on taste acuity begins very early.

On the other hand, there are sound psychological arguments to support the proposition that, through in-

creasing knowledge of the nature and magnitude of the difference, the accuracy of the subject's responses should tend to increase from judgment to judgment. It can be further argued that this increase should continue indefinitely, but at a declining rate.

Other important psychological considerations are the factors of motivation and attention. Attention is essential to success in the fine discrimination task called for in finished product testing, and attention can only be attained with strong and continuing motivation. It is reasonable to suppose that without special motivation the subjects' attention will fall off rapidly with increasing numbers of tests taken at a single sitting. It is conceivable also that each subject is capable of some fixed amount of effort and attention and that he will unconsciously spread this out to cover whatever number of tests he knows will be given. Thus he would devote less effort and less attention to each judgment as the number of tests increased and thereby lower his level of sensitivity. Such an effect would be very difficult to measure. Any reduction in the proportion of correct responses could as easily as not be attributed to the use of more uniform materials, whereas, if the same unchanging material were used in all tests, learning might confuse the issue.

Another consideration, especially important in the testing of beer and probably applicable to other products as well, is subject comfort. What total quantity of product can the subject consume during a short period of testing and still be comfortable and fully functional on returning to his normal duties? With participation on a voluntary basis, it seems reasonable to assume that the administration of too much material would probably result in a net loss of judgments through non-attendance of subjects. Because of this, any findings on sensitivity duration must be considered in view of subject comfort.

METHODS AND MATERIALS

The method used in this study was the duo-trio test, in which the subject receives in sequence samples identified as "control," "sample one" and "sample two." Either sample one or sample two is identical with the control (the paired samples) and the other is the different (odd) sample. The subject is instructed to select the different sample.

The product used in all tests was beer, the same pair of test materials being used throughout a single testing session. The samples, 12 ml. in size, were presented in ruby-colored glasses and the subjects were instructed to drink the entire quantity. A conditioner sample was presented prior to the test. The subject rinsed his mouth with water after the conditioner, before the start of the test proper, between tests, but not between the 3 samples of a single test. There was a 30-second interval between the conditioner and the first sample of a test and after each test before the start of the next. The subject was allowed to control the time interval between samples within a test. In order to implement any learning process, the subject was told after each judgment whether or not he was correct. All participating panel members (11 in number) were trained in the method prior to this study.

No special motivation was provided for this study. Any momentary increase in attention due to interest in the experiment should have been negligible in its overall effect since the data were collected over a period in excess of 6 months.

The study was conducted in 3 parts, the first involving 2 tests per session, the second involving 4, and the third using 5 tests. The entire group of subjects participated in all tests.

RESULTS AND DISCUSSION

Table 1 summarizes the results, showing the number of correct responses for each of the successive tests of a session and for each of the experimental conditions. The χ^2 analysis was made on the excess of correct responses over the number expected if there were no discrimination (50% of the total responses) since if we are to measure any change in sensitivity it will be in those responses which represent discrimination.

TABLE 1

Tabulation of correct responses by test number

	Number of responses on each test	Number of correct responses on each test					χ^2
		Test One	Test Two	Test Three	Test Four	Test Five	
Two tests per session	2025	1413	1431	—	—	—	0.4
Four tests per session	1162	845	829	852	861		2.1
Five tests per session	1300	877	905	961	972	934	20.9**

**Significance = .01.

The first line of the table shows the results with two tests per session. The χ^2 value indicates that there is no significant difference in sensitivity between the first and second tests although the second did yield a few more correct responses. This was expected because of similar results obtained on numerous products.

The second line of the table gives the results when there were 4 tests per session. The third and fourth tests gave more correct responses than either the first or second but the differences between tests are not significant. This is clear-cut evidence that there was no loss of sensitivity over the series of 4 tests.

Line 3 of the table gives the results of the 5-tests-per-session series. Here the distribution of correct responses over the 5 tests differs significantly from the distribution expected if the subjects were equally sensitive on all tests. There is an appreciably greater proportion of correct responses on the third, fourth, and fifth tests.

An analysis of the performance of individual subjects on the 5-test series showed that no test was significantly better for any single subject although one subject did significantly worse on the first test. However, the pattern was quite clear in that the majority of subjects, 8 out of 11, had their highest number of correct responses on the third, fourth, and fifth tests.

The obvious conclusion is that the subject learns on the early tests and through this knowledge becomes more accurate in his responses in succeeding tests. Certain subjective evidence was found in the comments of the panel members to substantiate the learning theory also. Many subjects felt on numerous occasions that after the first test or two they "found something" and would be correct on an indefinite number of tests.

Each successive test yielded more correct responses than the preceding test up to the fifth. It may be that here we are approaching the point of diminishing returns. This is supported by the comment made by

several subjects that the samples all started "tasting the same" by the time they had consumed the total of 16 samples required by the 5 tests. An interesting response to the problem of quantity consumed and to the learning factor was made by some of the panel who on several occasions, having learned or memorized the taste of the paired and the odd sample during the first few tests, eliminated one sample by not taking the first of the paired samples but merely picking out the odd sample on the last test or two. This seemed to occur, however, only when one of the samples being tested was somewhat unusual.

The overall percent correct responses when 2 tests were taken during a session was 70.1%. When 4 tests were taken the percent was 72.7% and when 5 tests were taken it was 71.2%. Since the materials being tested were about the same during the entire study, these data indicate that sensitivity remained fairly constant regardless of the number of tests per session.

These conclusions should hold true for other panels testing beer, but they may not be valid for panels testing different products, or even for panels using different methods on the same product. However, the data furnish additional evidence that using but one or two tests per session on any material may be an unjustified waste of time.

SUMMARY

The number of duo-trio tests on beer taken at a single testing session by each subject was increased from two to five. The extra tests (three, four, and five) rather than being less sensitive actually yielded significantly more correct responses than the first two tests. This supports the theory that a subject can learn from the first tests and profit by that knowledge on succeeding tests.

Acknowledgment

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Organoleptic Evaluation by Industry Panels—The Cutting Bee

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Food processors' cutting bees fulfill an important function by allowing industry members to compare and criticize their own products in a reasonably objective manner. Although it cannot be expected that these industry judging sessions can be made as precise an instrument for the evaluation of organoleptic properties as the small, selected, and trained panel working under controlled conditions, definite improvement in methodology is possible. Many if not most of these cuttings could be bettered, in fact, without appreciably increasing their complexity or adding to the technical problems involved. Application of some of the principles and techniques that have helped to make small panel organoleptic testing such a useful tool would achieve the desired result.

Such improvements can greatly increase the validity and informativeness, and hence the value, of industry judging sessions. An example of what actually has been accomplished along these lines is the cutting bee that is a standard feature of the annual technical conference of the California Olive Association. As the cutting bees were formerly conducted, each judge was required to evaluate all of the samples present—usually a rather considerable number. For each of these different olives he was expected to score three separate characteristics—flavor, texture, and appearance. Talking and smoking were permitted during the actual judging session. With such procedures, the cutting bees were bound to yield unreliable results. Too many separate samples meant that the judges were fatigued before the end of the session. Asking a judge to evaluate three different attributes did not permit him to concentrate on any one. It was also impossible to select judges on the basis of their special skill in evaluating a particular quality. Obviously, a situation in which judges are allowed to confer among themselves is not conducive to independent scoring. One or two individuals with outspoken opinions frequently tended to dominate, or at least strongly influence, the rest.

Furthermore, no attempt was made to subject the scoring to any sort of statistical analysis or comparison. As a result, conclusions based on the cutting bee were mainly conjectural. There was no way, except by fallible memory, of knowing how the samples of one year compared with those of previous years. Whether or not judges could reproduce their evaluation within reasonable limits was never put to test.

Realizing their difficulties—after being subjected to some criticism on the foregoing points—the Olive Association asked for assistance in devising a more satis-

factory program for their industry cutting bee. As a result of this request, the annual olive cutting bee has, since 1951, been more or less standardized and has been employing the best applicable testing methods. Since comparisons can now be made from one year to the next, the results are interesting in themselves. Even more important, perhaps, is the fact that an example of one possible design for conducting cutting bees is now available for examination.

THE METHOD

Ordinarily, about 70 to 80 samples are submitted for evaluation; these include a number of duplicates and "hold overs." (The latter are duplicates of some of the samples judged in the previous year's cutting bee. These samples are carefully stored at a cool temperature to minimize changes in flavor or other characteristics). All samples are purchased by impartial buyers in grocery stores in the Los Angeles and San Francisco areas. Types selected are divided among (a) whole, dark-ripe olives (40-50 samples), (b) pitted, dark-ripe olives (12-15 samples), and (c) green-ripe olives (12-15 samples). Each is scored for flavor, texture, and appearance with one exception. Green-ripe olives, due to the wide variation in opinion as to what this olive type should look like, are not judged for appearance; instead all samples are given the same score, the maximum being arbitrarily selected. Judges score the factor of flavor on an eleven-point scale; appearance and texture on six-point scales.[a] They are asked to comment on the individual samples, particularly on those that they have graded down. The sum of the scores of the individual judges is then multiplied by a factor which gives a maximum possible score of 50 for flavor and 25 each for texture and appearance. For example, if four judges have scored a sample for flavor, the sum of their scores is multiplied by 5/4 to obtain the flavor score for that sample.

About 40 individuals are normally available as judges. Each is assigned to scoring a single characteristic in a single type of olive. Since flavor is considered most important, more judges are assigned to score this factor than either of the other two. Except for those judges rating appearance (who do not have to taste the samples) no one is asked to score more than 14 or at most 18 samples. This number is admittedly rather large for a single session, but the judges are allowed plenty of time (30 to 60 minutes) to register their evaluations. Since the judges are thus exposed to a wider range of quality, the advantage probably outweighs the disadvantage.

In a briefing session preceding the actual cutting bee, the judges are instructed on the method of scoring samples. Points which should be considered in scoring each characteristic (i.e., intensity of characteristic olive flavor, presence or absence of various types of undesirable flavors in judging flavor; uniformity of size and color, freedom from fragments in the brine, etc.) are carefully delineated. The judges are requested to work independently, not to talk or otherwise influence their neighbor's judgments, not to smoke, etc. The importance of not allowing a poor appearance to adversely affect a flavor score, or poor flavor to influence texture judgment, is stressed; in practice, of course, it is very difficult for judges to separate completely these factors. At the briefing session the judges are given an opportunity to examine and taste a few "warm-up" olive samples which vary from *good* to *poor* in each of the characteristics to be considered.

Immediately following the cutting bee, the judges' scores are totaled and averaged. The flavor, texture, appearance, and total scores for each sample are then placed beside the pan containing those olives. Industry members and guests are invited to return and view the samples side by side with the ratings they achieved. The samples are identified by code number only, of course, but each processor is informed of the numbers of his own samples.

Each year, the scoring performance of the judges is analyzed for consistency of scores on duplicate samples and for deviation from the average, and lists of judges are modified accordingly. Judges who seem to do well are retained in their particular group, whereas those who score inconsistently and atypically are transferred to a group scoring for some other characteristic. It is possible that a poor flavor judge may make a good appearance judge or *vice versa*.

[a] Scoring scales:

	Flavor	Appearance and texture
Excellent	10	5
Good	8	4
Fair	5	2
Poor	2	1
Disqualified	0	0

RESULTS AND OBSERVATIONS

In Table 1 are summarized the average scores for the organoleptic characteristics of the three types of olives for the years 1951, 1952 and 1953. Using analysis of variance *(1)*, it was determined that there were no statistically significant differences (at the 95% probability level) between the three-year average scores for any particular classification of olives and the three-year average for the entire group. Comparisons were also made between average scores obtained for a given quality characteristic and olive type in a single year with the corresponding three-year average. In only a few instances—notably the whole, dark-ripe olives in 1951—were significant differences observed. This is partly because of the far smaller number of samples among the pitted, dark-ripe and the green-ripe olives, but it also seems to indicate a satisfactory stability in the judges' use of the scoring scale from year to year.

TABLE 1
Summary of cutting bee scores

Sample type and characteristic judged	1951 Ave.	1951 Range	1952 Ave.	1952 Range	1953 Ave.	1953 Range	Three-year average†
Whole, dark-ripe	(42 samples)		(49 samples)		(54 samples)		
Flavor	37.9**	20-50	30.0*	17-46	32.5	11-48	33.2
Texture	16.2**	5-23	18.5	8-25	19.3	3-25	18.5
Appearance	14.9*	7-25	18.6	6-25	17.6	5-25	17.2
Total score	69.4	33-85	68.2	45-88	69.3	24-93	69.0
Pitted, dark-ripe	(15 samples)		(10 samples)		(12 samples)		
Flavor	33.3	25-43	33.6	25-41	36.5	24-50	34.4
Texture	19.9	10-25	20.7	13-25	18.3	13-23	19.6
Appearance	17.9	8-23	19.3	11-25	17.4	10-25	18.1
Total score	71.7	45-84	73.6	56-83	72.2	60-93	72.4
Green-ripe	(15 samples)		(16 samples)		(14 samples)		
Flavor	30.7	13-47	31.8	10-42	31.1	5-45	31.2
Texture	17.0	7-23	18.6	13-23	15.9	5-25	17.2
Appearance	‡	‡	‡	‡	‡	‡	
Total score	73.0	55-89	76.1	53-90	72.0	42-93	73.8

† No significant differences (at 95% level) between any of these three-year averages for a particular type of olive and the average for all three olive types.

* Significantly different from three-year average at 95% probability level.

** Significantly different from three-year average at 99% probability level.

‡ All samples given 25 points.

Scores given to duplicate samples also furnish an indication of the reproducibility and validity of the cutting bee judgments. In Table 2 are summarized the average discrepancies in scores on duplicate samples. In general, the judges were able to replicate their scores quite satisfactorily, though there were several fairly large

differences. Flavor scores seem to be the least consistent, but the larger average differences here are due in part to the fact that the scoring range for flavor is twice as great as for appearance or texture.

TABLE 2
Average discrepancies in cutting-bee scores on duplicate olive samples

Year	No. of pairs of samples	Average difference between scores on duplicates			
		Flavor	Texture	Appearance	Total
1951	7	7.3	1.0	3.1	5.7
1952	6	4.2	1.7	0.8	6.3
1953	8	4.3	2.1	1.4	5.8

Since 1953, further changes and additions to the cutting bee procedure have been made and have yielded still more information. These include color and textural analyses of the samples by spectrophotometer and shear press respectively, and correlation of the industry judgments with the scores of a small, well-trained, non-industry panel.

SUMMARY

The informativeness and validity of the annual cutting bee of the olive industry have been greatly increased by simple procedural changes and by the application of generally recognized principles of taste testing. Comparisons may be made between individual samples, types of samples, pack years, and other factors of interest to growers, processors and consumers.

Acknowledgment

Most of the credit for the initiation and design of the revised cutting bee procedure is due to Dr. Emil Mrak, Chairman of the Department of Food Technology, University of California, and Miss Erlene Hevel, Secretary of the California Olive Association.

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The Value of Training a Sensory Test Panel[a,b,c]

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The value of training observers was investigated. A three-week training period was shown to result in improved performance with respect to judging aroma and flavor of ground beef at varying levels of rancidity.

Analytical judging by sensory test panels is an accepted and valuable technique in food research. Food quality is basically related to sensory perception, although physical and chemical methods are available for the measure of some quality factors. These latter have the virtue of objectivity. To enhance the value of the sensory or taste panel, objectivity should be increased and the personal preference of observers minimized. Reliable panel participation is not insured on the basis of any self-evaluation or interest in the immediate program. The management of the physical environment may approach perfection as to lighting, preparation of samples, consistency in time, number and size of samples to be judged, randomization of presentation and the elimination of suggestion; the value of the panel as an analytical tool still depends upon objectivity, precision and reproducibility in the judgments of the observers. Methods which will enhance these abilities and provide a measure of performance will aid in the selection of panels.

A recent article by Foster *(3)* cites the great care exercised in the preparation of materials to be tested and the exhaustive analysis of results, whereas the panel itself and its performance are given scant attention. Information is usually lacking that would enable another investigator to reproduce a sensory or palatability test. The need of standardization is emphasized by Foster for this type of testing for which the term *psychometrics* has been recommended. Others have pointed out the importance of comparable procedures of palatability testing among laboratories: Boggs and Hanson *(1)*, Peryam, Pilgrim, and Peterson *(2)*, Dawson and Harris *(6)*.

Standards must exist within a laboratory for uniform and comparable performance from panel to panel, time to time, and product to product. In this laboratory it has been found that in the selection of observers the very process of seeking the ability to discriminate and to reproduce judgments results in "training." Judging a consecutive series of tests results in improved performance with time. This article reports work undertaken to improve methods of selecting and training panels; to measure the improvement and performance; and to justify the expense in time and money for training where periodic taste testing is done. A group of previously untrained observers was used and their per-

[a] College of Home Economics Research Publication No. 128.
[b] Experiment Station Research Publication No. 2000.
[c] Based on a thesis by Barbara Spahr, offered in partial fulfillment of the Master of Science Degree.
[d] Present location—Department of Foods and Nutrition, Purdue University, Lafayette, Indiana.

formance followed. The work is presented as a step toward needed standardization.

METHODS AND PROCEDURES

The dilution test *(1)* used for training applies only to materials which can be made homogeneous. Ground beef was chosen as the test food. Twelve ground beef samples at varying levels of rancidity were presented to judges 15 times. The experiment was carried out over a period of 3 consecutive weeks, and 5 consecutive days each week.

Ten samples were prepared by diluting fresh ground beef with rancid ground beef, stored 12 months at 10° F., in the proportions shown in Table 1. In addition there were two completely fresh samples. After machine mixing, the meat was shaped into 70 g. patties approximately 4 inches in diameter and ½ inch thick. The patties were wrapped in aluminum foil, frozen and stored at —10° F. for the 3-week period of testing.

TABLE 1
Parts rancid and fresh beef in samples

Sample	Rancid beef parts	Fresh beef parts	Log conc. rancid beef
A	1	1023	$\bar{4}.990$
B	1	511	$\bar{3}.292$
C	1	255	$\bar{3}.592$
D	1	127	$\bar{3}.892$
E	1	63	$\bar{2}.194$
F	1	31	$\bar{2}.494$
G	1	15	$\bar{2}.796$
H	1	7	1.096
I	1	3	1.398
J	1	1	1.698

The cooking procedure was standardized in preliminary work. Six frozen, unseasoned samples were cooked at one time in an electric oven preheated to a temperature of 325° F. The cooking time was 23 minutes. At the end of this time the patties were slightly pink on the inside and still tender and juicy. Each patty was divided radially into 8 sections for testing.

The 7 individuals who served on the panel had no previous judging experience. The testing was done at 11:00 a.m. and the observers were seated in a row in a light, well ventilated room. Distracting noise and activity were eliminated. Samples were not swallowed and water was used to rinse the mouth between tastes. Aroma and flavor were the sensory qualities chosen to be scored.

Judges scored every treatment each day. The 10 experimental samples were randomized daily into 2 groups. In addition, each group contained a fresh sample, so that 2 groups of 6 samples were presented. Scoring for aroma was done first, then the samples were tasted and scored for flavor. There was a 30-minute interval between the two presentations to allow a period for discussion. In the discussion of the scoring, questions were answered and the observers given help toward becoming more objective and toward eliminating preferences. Samples were reviewed and re-tested to fix differences in the minds of observers.

Aroma and flavor were scored by a 5-point scale with descriptive terms. A score of one denoted highly undesirable aroma and strong off-flavor; five denoted highly desirable aroma and no off-flavor. Written preliminary instructions were given the observers *(4)*. These were discussed with the group before any testing and were referred to as questions arose.

RESULTS AND DISCUSSION

Data presented are based on the findings of the first and third, or last, week of the investigation. The unpresented data of the second week were intermediate in range. During the first week the scoring of both qualities, aroma and flavor, was inconsistent. There was limited use made of the scoring range and marked differences in the performance of individuals. In the third week there was a pronounced trend toward uniformity shown by the observers (Table 2).

This tabulation presents as a measure of performance the regression formulae, $y = a + bx$, calculated by the method of least squares, for individuals and the group, based on the scores versus the log of the concentration of rancid beef. The scores given the fresh patties (concentration of rancid beef, zero) were not used in calculating these regressions. The panel as a whole improved with training, the increase in the slope showed a greater use of the scoring range than was made initially. Similarity of the slope of the regression lines for the third week contrasts with the diversity of those the first week. A comparison of the regression values for the two periods provides evidence that for the taste panel in this experiment, the training resulted in improved performance for both the individuals and the group. For some, e.g., observers 1, 2 and 5, the improvement was considerable.

The improvement of performance is presented for one individual, observer 2, and for the panel (Figure 1). This observer during the first week used a scoring range of 1.4 units for aroma in the dilution series 1:1023 to 1:1. For the third week the range had increased to 3.4 units. She initially showed better ability to judge flavor than aroma, but by the third week she was judging both qualities with approximately equal discrimination. The final performance of the panel is close to that of this observer although the group judgments were better at first than hers were.

While these regression formulae and lines give evidence of improvement of the panel with training, they

TABLE 2
Formulae of regression, $y = a + bx$, for performance of observers and panel before and after training, x = log of concentration

Observers	Aroma		Flavor	
	1st Week	3rd Week	1st Week	3rd Week
1	$y = 6.2 - 0.41 \log c$	$y = 13.0 - 1.20 \log c$	$y = 6.0 - 0.34 \log c$	$y = 13.8 - 1.28 \log c$
2	$y = 7.9 - 0.51 \log c$	$y = 13.8 - 1.28 \log c$	$y = 10.1 - 0.76 \log c$	$y = 14.0 - 1.28 \log c$
3	$y = 13.2 - 1.22 \log c$	$y = 14.9 - 1.34 \log c$	$y = 14.1 - 1.32 \log c$	$y = 13.2 - 1.28 \log c$
4	$y = 10.3 - 0.88 \log c$	$y = 13.2 - 1.19 \log c$	$y = 12.9 - 1.18 \log c$	$y = 13.8 - 1.30 \log c$
5	$y = 8.0 - 0.59 \log c$	$y = 11.2 - 1.06 \log c$	$y = 5.5 - 0.26 \log c$	$y = 13.0 - 1.18 \log c$
6	$y = 11.8 - 1.04 \log c$	$y = 12.8 - 1.20 \log c$	$y = 11.3 - 1.02 \log c$	$y = 13.8 - 1.30 \log c$
7	$y = 10.7 - 0.90 \log c$	$y = 14.4 - 1.36 \log c$	$y = 9.0 - 0.71 \log c$	$y = 13.5 - 1.31 \log c$
Panel	$y = 9.7 - 0.78 \log c$	$y = 13.3 - 1.24 \log c$	$y = 10.3 - 0.85 \log c$	$y = 13.8 - 1.29 \log c$

are an over-simplification which obscures many informative data which such training provides the investigator. Although observers were "brought in line," there was evidence that after training some observers remained less useful as judges than others.

For the range of concentration of rancid beef used, judgments improved more for the extremes than for the intermediate concentrations. Some observers had limited ability to rank intermediate samples and to detect small differences. Individual data served to screen these observers. While the ability to detect small

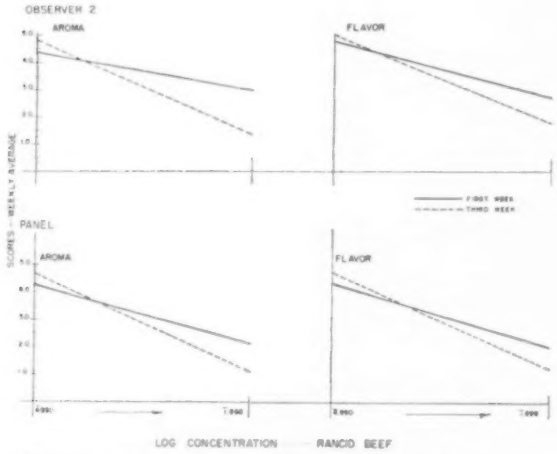

Figure 1. Regression lines based on scoring performance of observer 2 and of the panel, first and third week.

differences improved with training, the greatest variations persisted in the middle range. In Figure 2 is presented the distribution of the variance (the square of the standard deviation) of the mean scores of the panel for aroma and flavor for the first and third weeks.

For aroma during the first week the variance about the mean score ranged from 0.6 to 1.3 in haphazard fashion; after training the variance decreased to a range of 0.03 to 0.87. The distribution began to resemble a normal curve and indicated improved reproducibility in judging, especially for the more rancid meat. The largest variance was for the intermediate concentrations. For flavor much the same was true, the distribution of the variance with training tended to become normally distributed with the best consistency of judgments at the extremes of concentrations. Similar results have been obtained by Hopkins *(5)*.

While the data presented (Table 2, Figures 1, 2) show over-all change with training, the changes in mean

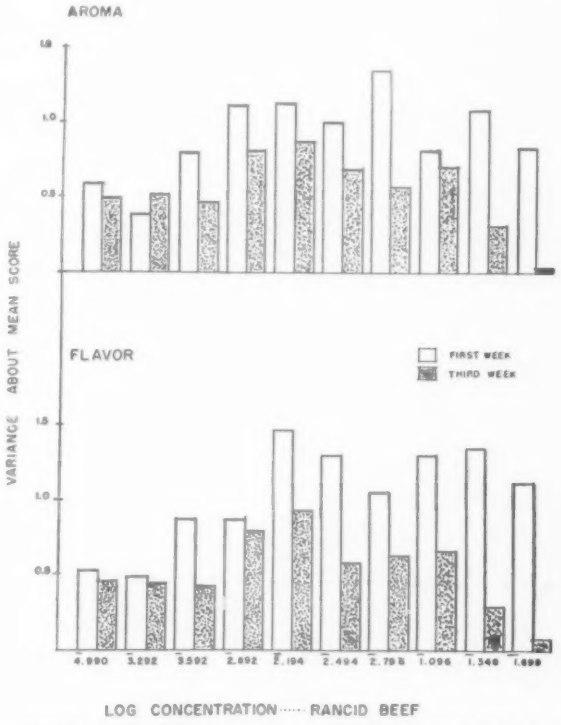

Figure 2. Distribution of variance (square of standard deviation) for the panel about mean score for aroma and flavor first and third week.

scores are obscured. Typical data are shown in Table 3 for the mean scores for aroma with standard errors, before and after training, for the panel and judges 2 and 7, for concentrations of rancid beef 1 : 1023, 1 : 127 and 1 : 1.

TABLE 3

Comparison at three concentration levels of rancid beef during first and third week of training
Aroma mean scores and standard errors

	Concentration								
	(A) 1:1023			(D) 1:127			(J) 1:1		
Observer	Panel	Obs. 2	Obs. 7	Panel	Obs. 2	Obs. 7	Panel	Obs. 2	Obs. 7
No. of observations	35	5	5	35	5	5	35	5	5
	First Week								
Mean Score	3.9	4.2	3.4	3.5	4.6	3.6	1.8	2.8	1.6
Standard Error	0.291	0.580	0.245	0.396	0.245	0.397	0.343	0.157	0.397
	Third Week								
Mean Score	4.4	4.8	4.4	3.6	3.8	4.2	1.0	1.0	1.0
Standard Error	0.272	0.201	0.397	0.336	0.375	0.375	0.064	0	0

These data give direct evidence of the initial diversity between these two judges and the panel in scoring samples as well as the trend toward uniformity and the greater use of the scoring range with training. For the panel the range increased from 2.1 to 3.4 units; for subject 2 from 1.4 to 3.8 units; for subject 7 from 1.8 to 2.4 units.

Variability of performance is shown by the standard error of these means. They serve as a measure of the degree of ability to reproduce judgments. The direct statistical comparison of means as a measure of difference in performance, e.g., period to period, subject to subject, subject to panel or sample to sample is of limited value. Relatively large differences may be rendered non-significant by virtue of initial, continued or erratic high variability, while smaller differences between means for some concentrations may become significant because of ability to reproduce judgments. These data indicate the usefulness of a measure of variance in judging individual performance and so provide a means of screening to obtain reliable observers for panel participation.

Four of the observers were in their early twenties, two in the thirties, and one in the fifties. Four of the seven smoked. The group was too small to permit a study of these factors, but there was no evidence that they played a part in performance. There was initially a general preference for the slightly rancid patties over the fresh ones. While the preference probably remained, some of the observers became able to separate preference from recognition and to become objective in their scoring.

SUMMARY

In an investigation of the value of training observers for participating on sensory test panels, a three-week period of training resulted in improved performance in judging aroma and flavor of varying concentrations of rancid beef. The improved performance of individuals and of the group was judged by a comparison of the regression formulae of scores versus the log of the concentration of the rancid beef.

Variance about the mean scores was used as a measure of the reproducibility of scores. Consistency of performance was improved by training and was greatest for the extremes of quality, the least and most rancid samples.

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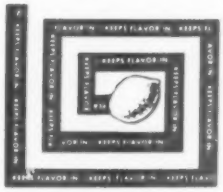

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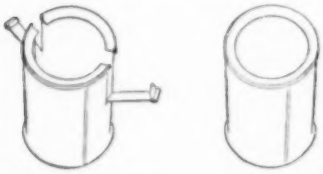

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(Continued from page 40 preceding technical papers)

less than 75% of the Natl. Res. Council recommended allowances for calories, riboflavin, Fe and ascorbic acid. Milk, or its equivalent in cheese, yellow and leafy green vegetables were the foods most often slighted by both men and women.

PHYSIOLOGY AND MEDICINE

Electrophoretic separation of hemoglobins from the chicken.

JOHNSON, V. L., AND DUNLAP, J. S. (State Coll. of Wash., Pullman). *Science, 122,* 1186 (1955).

Investigations of the dissociation of oxyhemoglobin in birds have led to the suggestion that there are two hemoglobins, one embryonic and one adult. Electrophoretic methods were successfully used in sepg. mammalian hemoglobins. It appeared that the nature of avian hemoglobins could profitably be examd. by a similar technique.

Chromatographic fractionation of normal adult oxyhemoglobin.

MORRISON, M., AND COOK, J. L. (Univ. Rochester Med. Sch., N. Y.). *Science, 122,* 920-1 (1955).

This is the first report of a sepn. of undenatured normal adult hemoglobin into various fractions. The differences in these fractions are now under investigation.

Separation of complete and incomplete Rh antibodies by centrifugation.

CAMPBELL, D. H., STURGEON, P., AND VINOGRAD, J. R. (Calif. Inst. Technol. Pasadena). *Science, 122,* 1091-2 (1955).

Experiments clearly indicated that Rh saline agglutinins sedimented at a faster rate than the incomplete type of antibodies. They also suggest that practical sepn. of agglutinating and nonagglutinating types of antibodies can be accomplished by centrifugation.

Chemical target: cancer.

Chem. Eng. News, 33, 5138-42 (1955).

Review of progress and achievements in search for chemotherapeutic agents which will cure cancer. Article includes chart of typical chemicals for cancer chemotherapy showing formulae and applications.

Urinary excretion after the age of ninety. A study of neutral 17-ketosteroids, creatinine, and creatine.

HOWELL, T. H. (Geriatric Res. Unit, St. John's Hosp., Battersea, London). *J. Gerontol., 11,* 61-5 (1956).

A group of subjects, all aged 90 or over, excreted less neutral 17-ketosteroids and creatinine than younger adults. Every subject showed small amts. of creatinine in the urine. These findings suggest that the physiology of subjects over the age of 90 differs considerably from that of younger adults.

FOOD AND FOOD TECHNOLOGY

ANIMAL FEEDS

Scientists study possibility of growing algae in sewage to produce feed.

Feedstuffs, 16, November, 1955.

Description of methods used for "sewage farm" research at Univ. of Calif. Coll. of Agr., Berkeley, directed by Dr. Harold Gotaas. Potential yield of high protein animal feeding ration is estd. at approx. 4,000 tons a day if sewage could be treated on a nationwide scale.

BEVERAGES

Tests show hyperacidity reduced by soft drink use.

National Bottler's Gazette, 74 (884) 4-5 (1955); Continental Can Company, Abstracts, *250* (1955).

Scientific tests completed at Yale disclose that carbonated H_2O, through more rapid evacuation of a test meal, also causes a diminished total secretion of acid in the stomach; thus relief from gastric retention and subsequent hyperacidity may be afforded by this effect of carbonated H_2O.

CEREALS AND GRAINS

Further observations on the improvement of polished rice with protein and amino acid supplements.

DESHPANDE, P. D., HARPER, A. E., QUIROS-PEREZ, F., AND ELVEHJEM, C. A. (Dept. Biochem., Univ. Wis., Madison). *J. Nutrition, 57,* 415-28 (1955).

The effects of various supplements of protein and amino acids on growth and on the deposition of liver fat in rats receiving a rice diet were investigated. A rice diet supplemented with 6% of various animal proteins supported an excellent rate of growth and maintained liver fat at normal levels. In short expts. (2 weeks) the retardation in growth caused by including 0.4% of L-lysine·HCl in the rice diet was prevented by increasing the levels of leucine, isoleucine, valine and histidine. In longer expts. the growth-retarding effect of addnl. lysine disappeared without the addn. of other amino acids to the dict. The sequence in which the amino acids of polished rice became limiting for growth was found to differ markedly from that calcd. from amino acid analyses.

Feeding value of stored corn.

CABELL, C. A., AND ELLIS, N. R. *J. Animal Sci., 14,* 1167-73 (1955).

Nine samples of stored surplus corn ranging from 1 to 6 yrs. old were tested by rat feeding expts. to est. possible deterioration of nutritive value. When fed as a source of energy in mixed diets, no loss in feeding value was found in samples stored as long as 6 yrs.

COCOA AND COCOA PRODUCTS

Determining fineness in chocolate and cocoa.

WELCH, R. C. (Wilbur-Suchard Chocolate Co.). *Confectioners J., 82, 22* (1956).

Discussion and description of general methods for detg. fineness in chocolate products. One microscopic technique used is thinning a small amt. of test material with suitable fat solvent, spreading on microscope slide, drying and examg. under standard test conditions and studying particle size. Micrometer test procedure (Kempf) and sieve tests by ether washing are described in detail.

Crystallization controlled through radiant cooling.

MORGAN, E. H. *Confectioners J., 82,* 26-30, January 1956.

(Continued on page 46)

When shoppers compare your products with other brands...

...CELITE FILTRATION provides perfect clarity... assures appetizing appeal

In today's highly competitive market, it is vitally important that processed food products *look* good as well as *taste* good. For in a shopper's eye clarity is often a measure of purity. That's why so many processors are turning to Celite* diatomite filtration.

By means of a filter cake hundreds of times finer than the finest wire mesh, Celite polishes liquids to a dazzling clarity. And it does it economically, too. Celite is low in cost. It provides practically automatic operation with any standard pressure filter. And you needn't worry about a clarification bottleneck. Celite works at fastest flow rates.

Thousands of processors are using Celite today for filtering sugar, beer, fruit juices and jellies, cooking and salad oils and many other products. Why not ask one of them about Celite. Better still, get the complete story from Johns-Manville.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products

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NEWS! Important beneficial ingredient in dry food mixes

Now! Where rapid solubility is vitally important, use quickly dissolving Kelco algin colloids in your dry food mixes to improve taste, texture and stability of the finished product.

Use Kelco algin in your dry salad and meat sauce mixes: Kelco algin, a superior emulsion stabilizer is now finding wider and wider use in acidic emulsions. It promotes complete and rapid solubility even when cold mixed.

Use Kelco algin in quick mix puddings, gels and icings: The addition of Kelco algin enables dry mix puddings and gels to set up rapidly and firmly upon simple mixing with either cold or hot liquids. Water gels formed are clear and appetizing, while milk gels are creamier, smoother and tastier. Icing mixes containing this versatile algin are highly soluble and produce a finished icing with finer texture, softer body, and better moisture retention properties.

Yours On Request: "Technical Bulletin" fully describing the application of Kelco algin products in food uses. Without obligation, write for your copy today.

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Cable Address: Kelcoalgin — New York

(Continued from page 44)

Numerous tests conducted in and out of candy plants on chocolate and chocolate-coated candy reveal that radiant cooling achieves faster heat transfer, induces selective crystn. and gives greater production per square foot of floor space than air-cooled tunnels.

FATS AND OILS

A study of the flavor stability and autoxidation of beef fats.

Chang, S. S., and Kummerow, F. A. (Dept. Food Technol., Univ. Ill., Urbana). *J. Am. Oil Chemists Soc., 32,* 547-51 (1955).

The odoriferous compds. isolated from fresh edible tallow were found to be complex in nature. Upon removal by deodorization, the resulting bland tallow developed on autoxidation other types of odoriferous compds. which have been assocd. with flavor reversion in edible oils.

FRUITS AND VEGETABLES

Bitter flavor in carrots. I. A tentative spectrophotometric method for the estimation of bitterness.

Sondheimer, E., Phillips, W. F., and Atkin, J. D. (N. Y. State Agr. Expt. Sta., Cornell Univ.) *Food Research, 20,* 659-65 (1955).

Good correlation was obtained between u. v. absorption of hydrocarbon exts. and taste panel scores.

GELATIN AND GUMS

The structure of collagen.

Rich, A., and Crick, F. H. C. (Cavendish Lab., Cambridge, Mass.). *Nature, 176,* 915-16 (1955).

The general agreement with the x-ray pattern, the close resemblance to polyproline and to polyglycine, and the ability to explain the major features of the amino-acid sequence data all suggest that collagen is a structure of this type; that is, a three-chain, coiled-coil structure, with one set of systematic hydrogen bonds.

The function of hydroxyproline in collagens.

Gustavson, K. H. (Swedish Tanning Res. Inst., Stockholm). *Nature, 175,* 70 (1955).

Evidence based on the different hydroxyproline content of mammalian and fish collagens suggests that an important part of the interchain stabilization of the collagen structure is due to hydrogen bonding between the hydroxyl group of hydroxyproline and the keto group of the adjacent polypeptide chain.

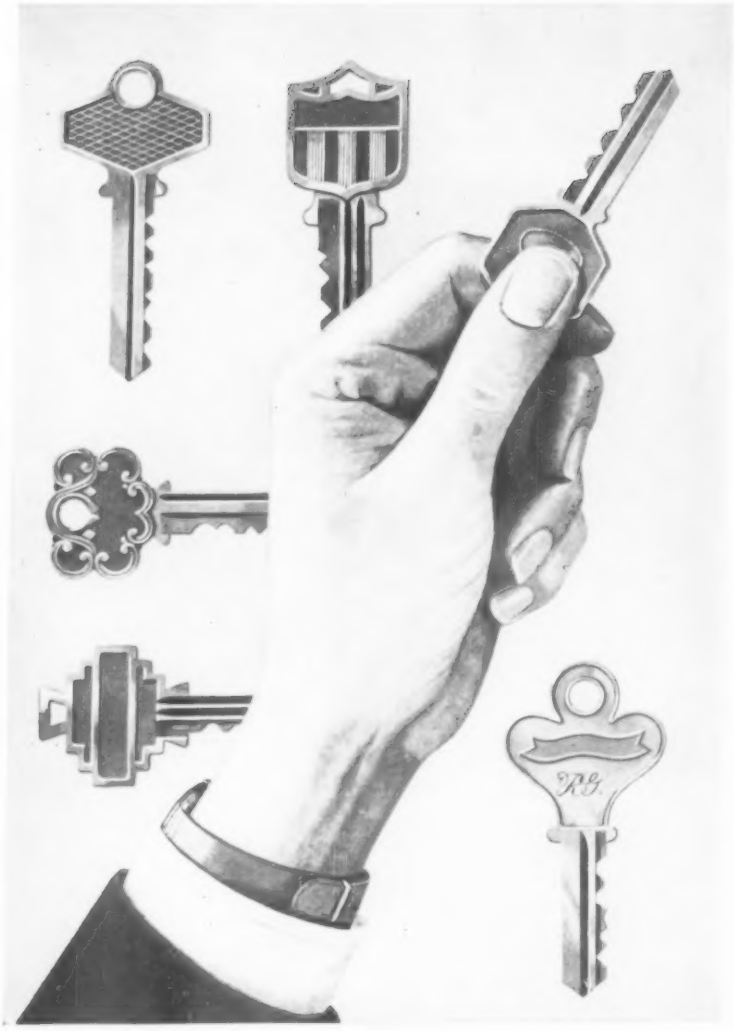
LEGISLATION

Procedures for the appraisal of the toxicity of chemicals in foods, drugs, and cosmetics.

Lehman, A. J., Patterson, W. I., Davidow, B., Hagan, E. C., Woodard, G., Laug, E. P., Frawley, J. P., Fitzhugh, O. G., Bourke, A. R., Draize, J. H., Nelson, A. A., and Vos, B. J. *Food, Drug, Cosmetic Law J., 10,* 679-748 (1955).

Outlines the techniques involved before a new additive can be deemed safe for use in foods, drugs, or cosmetics.

(Continued on page 48)



Maybe this is just the one for you!

Our staff of able men—whose lives are devoted to solving "unsolvable" problems—may have the precise key to your present container problem *right now.*

If they haven't, they will devote their time to fashioning a key that *will be.*

You see, the equipment and facilities available to our 350 highly skilled scientists and technicians are not surpassed in the industry. Nor is their record of achievement.

Canco customers have been out in front *first* with almost every new and better container—and frequently with an improved product within that container. And that's the record not just for this year. Or last year. But since the turn of the century.

AMERICAN CAN COMPANY

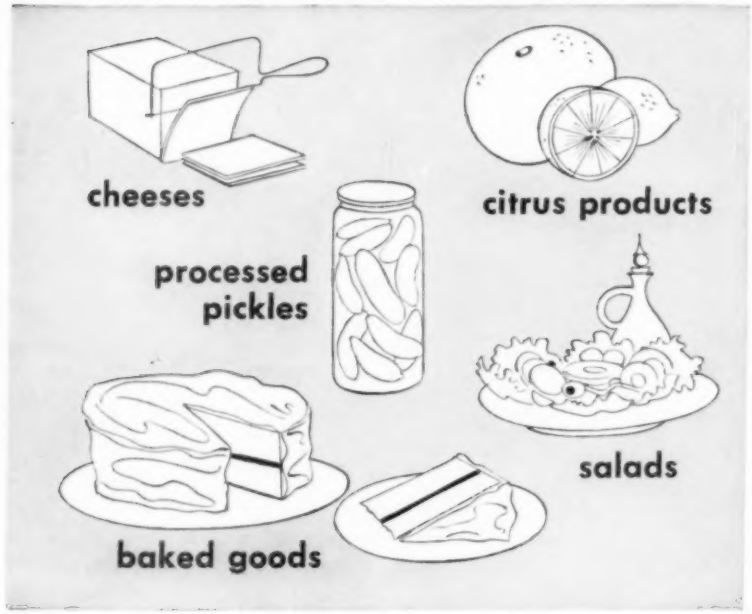
New York · Chicago · San Francisco

COME TO CANCO FIRST!

CARBIDE is the source for

SORBIC*

a ***NEW*** *selective food fungistat for . . .*



- Sorbic can be used with confidence at required levels—it is metabolized like fatty acids in foods.
- Sorbic controls growth of many undesirable microorganisms in foods.
- Sorbic can be so used that it permits the growth of many of the desirable organisms.
- Sorbic contributes no flavor at required concentrations in foods so far tested.

For further information write the CARBIDE office nearest you for technical bulletin F-6568. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal and Toronto.

* CARBIDE's *refined sorbic acid for use in foods.*

CARBIDE and CARBON CHEMICALS COMPANY
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street UCC **New York 17, N. Y.**

(Continued from page 46)

NUTS

Peanut research programs set to solve important problems.

BIRDSONG, B. M. *Peanut J., 35,* 11 (1955).

Research by Government scientists in New Orleans, will cover the following subjects: (1) chem. compn. of peanuts; (2) compn. of rapidly cured peanuts; (3) chem. changes in processed peanut products; (4) utilization of peanut shells and skins; (5) blanching of peanuts; (6) investigation of the grinding properties of roasted peanuts; (7) new food products from peanuts; (8) new food uses for peanut protein; and (9) improved retention of salt by peanuts.

PRESERVATION

Sorbic acid as a fungistatic agent for foods. X. Spectrophotometric determination of sorbic acid in foods in general.

LUCKMAN, F. H., AND MELNICK, D. (Res. Labs., The Best Foods, Inc., Bayonne, N. J.). *Food Research 20,* 649-54 (1955).

The method developed for cheese has been successfully applied to breads, cakes, bread spreads, fruit juices, syrups, jams, meats, etc.

STARCH

Food microscopy. Part one: Starches and flours.

ESSEX, C. D., AND SHELTON, J. H. (Oxo Limited, England). *Food, 25,* 3-7, January 1956.

This is the first of a series of articles dealing with the identification of foods and their adulterants with the aid of the microscope. Part I includes methods for prepn. of starch and flour specimens for examn. to det. grain size and gives general description of characteristics of maize, rice, wheat, barley, oats and rye cereal starches; also the non-cereal starches, potato, tapioca, sago, bean, pea, lentil, arrowroot and canna. Illustrated.

ORGANIC CHEMISTRY

Investigation of the synthesis of fatty acids.

Przemysl Chem., 11 (8) 457-62 (1955); *Battelle Tech. Rev., 4,* 14651 (1955).

The influence of temp., air flow velocity, and addn. of catalyst on oxidation rate and the properties of products from the synthesis of fatty acids from paraffin wax are described. Diagrams, table, graphs, 15 ref.

PATENTS

Processed food and method of preparation.

BURT, L. H. Assignor to Hercules Powder Company. *2,728,676,* December *27,* 1955.

A food preservation process which comprises drawing a vacuum on apple slices, blanching the apple slices in an aq. sugar soln. contg. between about 0.2 and about 1% by wt. of carboxyalkyl cellulose deriv. to maintain firmness and natural color of the apple slices, and preserving the blanched apple slices in the aq. sugar soln.

ATLAS *Food Facts*

FOOD INDUSTRY DEPARTMENT
CHEMICALS DIVISION

ATLAS POWDER COMPANY
WILMINGTON 99, DELAWARE

SORBITOL PROTECTS FOOD FLAVOR AND SHELF LIFE, HELPS SOLVE MANY FOOD FORMULATING PROBLEMS

Significant advances in food processing are being achieved through Atlas sorbitol, used principally as a conditioning agent to retain softness and moisture and improve texture, taste, and keeping qualities of many types of food.

IN CANDY MAKING. Sorbitol modifies the crystal structure of mixed sugar systems . . . keeping candies soft and tasty longer. Sorbitol also helps stabilize moisture content under varying temperature and humidity conditions . . . so candies remain "just right"—not too soggy in humid weather; nor too hard in dry weather. In general, sorbitol works best in aerated candies having a relatively high moisture content.

Works as a player on a team. A concentrated sorbitol solution will "set up" or crystallize when subjected to cold or low humidity temperatures. But when added to other candy ingredients, sorbitol acts like a player on a team . . . working with the mixed sugar systems to maintain softness and palatability to a much greater degree than can be obtained without sorbitol.

IN PROTEIN WHIPS. Viscosity and specific gravity of an aqueous sorbitol solution of given concentration are both slightly lower than a sucrose solution of the same concentration. One might speculate which of these characteristics explains why sorbitol solutions produce more stable and lighter whips than sucrose solutions. Protein whips having an unusual low range of density with good stability are produced using sorbitol.

IN DIETETIC SOFT DRINKS sorbitol is used for flavor dispersion and bodying purposes in low calorie soft drinks . . . improving "mouth feel" and adding new taste appeal. Only a small amount of sorbitol . . . 1 to 1.5% of the finished beverage . . . can make a big difference in the consumer acceptance of the soft drink. Call or write Atlas for more facts on the remarkable properties of sorbitol and how they can be applied to advantage in your product.

WHAT IS SORBITOL?

Chemically, sorbitol is a six-carbon, straight-chain hexahydric alcohol. It is found naturally in a wide variety of fruits, berries, and plants; but, it is produced commercially by treating the common sugars—cane, beet, or corn—with hydrogen.

In the pure form, sorbitol is a white, odorless crystalline powder. Usually supplied as a 70% aqueous solution, SORBO®, it is also available in powder and pellet form.

Sorbitol has a mildly sweet cool pleasant taste which blends well with other food ingredients.

Not subject to seasonal fluctuations in price or supply, sorbitol is made from an inexhaustible raw material—sugar; and is not a by-product; so production is not limited by the demand for an unrelated primary product. Through war and inflation, its price has been on a steadily downward trend for 15 years.

Question . . .

Three of the many groups of foods and beverages that are increasing sales with Pfizer vitamin fortification and enrichment:

● You can give carbonated beverages health appeal for just a fraction of a cent per bottle. That's all Pfizer vitamin-fortification costs. Bottlers are already using Vitamins B_1 and C to boost sales to today's vitamin-conscious public. Vitamin B_{12}, a factor in child growth, is also being considered.

● It's a smart sales move to enrich flour, macaroni, corn meal and similar products with Pfizer BI-CAP® enrichment concentrates. They give such products more food value. Let Pfizer show you how BI-CAP can add sales appeal to your product.

● To fortify your sales position in the canned juice, concentrate and fruit "ade" market, fortify these products with Pfizer vitamins. "Vitamin Fortified" on your label is a strong sales inducement. What's more, your vitamin content is standardized to offset processing losses and seasonal variations.

What's the most powerful appeal to the food shopper?

Answer . . . Her family's health!

Here's how to put it in and on your package!

● There's something very basic about the grocery business that's so simple and true that it's often overlooked. More vital to the *permanent sales position* of your food product than all the temporary give-away promotions is *the fundamental desire of every homemaker to provide her family with the maximum in health-giving nourishment.* That's why Pfizer's vitamin fortification and enrichment program fits in so well with any contemplated improvements in your product. Your Pfizer sales representative is prepared to give you full details on how Pfizer vitamins can powerfully increase your product's sales potential. Remember that Pfizer has been a major vitamin research and production center since the first vitamin was commercially produced.

Manufacturing Chemists for Over 100 Years **Pfizer**

CHAS. PFIZER & CO., INC.

Chemical Sales Division

630 Flushing Ave., Brooklyn 6, N. Y.

Branch Offices: Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.

With this new, sectional design Niagara condenser you avoid the many troubles due to faulty condensing and get at all times the full capacity your refrigerating plant should afford.

You benefit from extra saving in upkeep labor and expense. The casing of this new condenser is made of sections each separately removable, giving you access to all parts for easy inspection to head off dirt and corrosion, to clean the coils easily from either side.

You benefit from greater efficiency in condensing. A simpler method of using evaporative cooling improves heat transfer. You benefit from Niagara features that remove super-heat before condensing and keep the system purged of oil. You save 95% of the cooling water cost.

You benefit from a low first cost, lower freight cost and less expense in erection.

Capacity range is from 90 to 240 tons. Write for Niagara Bulletin 131. Find out how your plant can save expense this season.

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District Engineers in Principal Cities

NIAGARA — *Over 40 Years' Service in Industrial Air Engineering*

FOOD INDUSTRY TOPICS

(Continued from page 34 preceding technical papers)

tene with vitamin A (either natural or synthetic) in batch size containers made to the specifications of each individual customer and with the potencies fully guaranteed.

◆ ◆ ◆

Givaudan Flavors Inc., 330 W. 42nd St., New York 36, N.Y., announce Imitation Pear Flavor F-2180—a product that truly reproduces the ripe sweet character of the natural pear in a form which is stable under the most severe processing conditions. It is especially suitable for hard candies at concentrations of 1 to 1½ ounces per 100 pounds of hard candy stock. Samples are available.

◆ ◆ ◆

A radically new type of liquid-feed blender for commercial processing that blends liquid and dry materials swiftly in one operation has been perfected by Patterson-Kelley Co., Inc., East Stroudsburg, Pa. Designed as an integral part of the p-k twin shell blender, the liquid-feed modification makes it possible to feed liquids evenly into dry materials during blending. The device consists of an improved intensifier bar which revolves inside the p-k twin shell blender. Liquid flows from a hollow feeder tube within the bar, onto a revolving offset disk. Liquid droplets are flung from the edge of the revolving disk by the slinging action of centrifugal force. This slinging action, combined with the wiping action of the dry material on the disk, achieves effective dispersion. A cylindrical wire cage surrounding the intensifier bar and revolving with it prevents formation of clumps.

p-k twin shell blender

◆ ◆ ◆

Three government agencies have accepted use of the new, odorless Citroflex A-2 as a plasticizer for synthetic film packaging material for both fatty and non-fatty foods, it was announced by Chas. Pfizer & Co., Inc., 630 Flushing Ave., Brooklyn 6, N.Y. The Food and Drug Administration initially accepted the use of the product—a derivative of citric acid—on the basis of its superior toxicological safety. The Meat Inspection Branch of the USDA and the QM Food and Container Institute subsequently followed with their respective acceptances. Write the firm's Chemical Sales Division for data bulletin and samples.

◆ ◆ ◆

A superior whipping agent for vegetable fat toppings, introduced by Sheffield Chemical, Division of Sheffield Farms Co., Inc., Norwich, N.Y., and known as SHEFTENE Whipping Compound, is an enzyme modified milk protein concentrate which is non-coagulating with heat. It remains completely stable under boiling temperature. SHEFTENE Whipping Compound is not a milk powder and does not contain lactose or whey. Its action as a milk emulsifier and sta-

(Continued on page 54)

More Profits

through Proctor Drying Ranges

- Newest Pre-forming Techniques
- Improved Air Distribution
- Faster, More Uniform Drying
- Flexibility of Operation
- Guaranteed Product Quality

PROCTOR CONTINUOUS CONVEYOR DRYER
AT NATIONAL YEAST COMPANY

Yeast requires sensitive drying methods. This Proctor & Schwartz installation at National Yeast Company maintains the uniform quality, color, and viability of the yeast at considerably increased drying rates.

Proctor equipment provides the control and flexibility essential to profitable drying performance. Many wet-solid materials heretofore unsuited to conveyor drying can now be handled with speed and efficiency. And, as with all Proctor equipment, guarantee *is in terms of finished product produced.*

WRITE FOR BULLETIN #390

PROCTOR DRYING EQUIPMENT — **WRITE FOR DETAILED INFORMATION**

- Tray Dryers
- Truck Dryers
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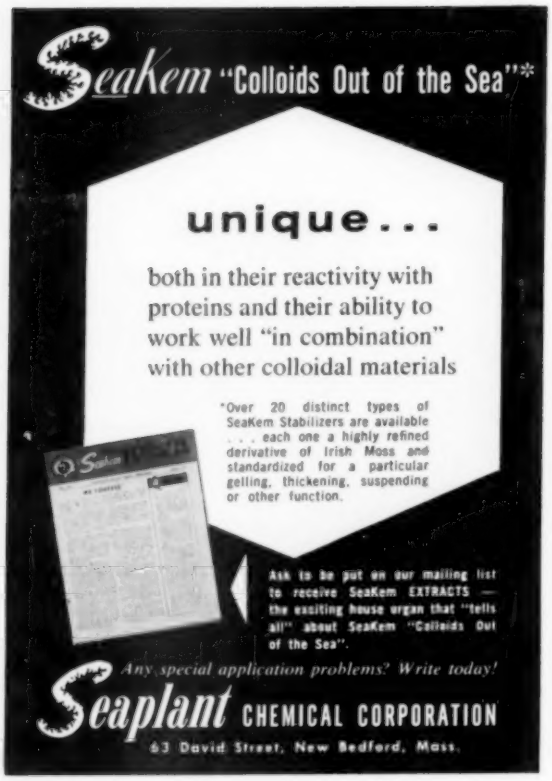
Manufacturers of Industrial Drying Equipment and Textile Machinery — Philadelphia 20, Pa.

• grains


Seakem "Colloids Out of the Sea"*
unique...
both in their reactivity with proteins and their ability to work well "in combination" with other colloidal materials
*Over 20 distinct types of SeaKem Stabilizers are available . . . each one a highly refined derivative of Irish Moss and standardized for a particular gelling, thickening, suspending or other function.
Ask to be put on our mailing list to receive SeaKem EXTRACTS — the exciting house organ that "tells all" about SeaKem "Colloids Out of the Sea".
Any special application problems? Write today!
Seaplant CHEMICAL CORPORATION
63 David Street, New Bedford, Mass.

(Continued from page 52)

bilizer and its compatibility with fats has allowed its use in icing bases, confectionery, and bakery specialty systems. Available in commercial quantities, SHEFTENE is a non-hygroscopic powder of bland flavor and neutral odor. Write for bulletin.

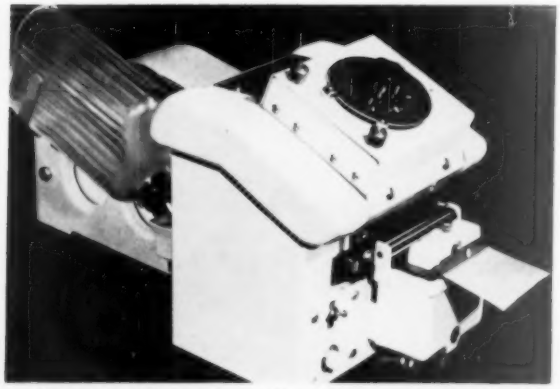
◆ ◆ ◆

A new system of proportioning, mixing, and dispensing two liquids in the same operation has been announced by G. Diehl Mateer Co., Strafford, Wayne, Pa. Important advantage of the system is that it provides an adjustable means of accurately controlling volume of mixture dispensed while maintaining proportions of the two liquids delivered to the mixture at all times. This is accomplished by using a common drive for both metering pumps and employing the Mateer principle for controlling the cycle. By changing the settings of a dial, volume of both pumps is increased or decreased proportionally, without changing the ratio of the two liquids delivered to the mixer. This provides a wide range of adjustment in the over-all volume of the combined liquids dispensed from the mixer.

◆ ◆ ◆

The difficult task of sorting lemons by color into 5 distinct groups is carried out fully automatically by the phototube at Somis Lemon Assn., Oxnard, Calif. The lemons, which arrive at the plant in colors ranging from dark green to dark yellow, are handled as delicately as eggs by a battery of 6 ESM units at the rate of 1,000,000 per day. The electronic equipment which sorts this crop into appropriate color groups is manufactured by Electric Sorting Machine Co., Grand Rapids, Mich.

◆ ◆ ◆



The DIAL-TAPER (dial operated) delivers any length of tape in any sequence—for sealing cartons of mixed sizes. The TWIN-TAPER (button or remote automatic operated), illustrated, delivers any two pre-set lengths of tape for production taping of cartons of uniform size. These machines also will cut reinforced tapes. Both units have built-in electric water heater and thermostat for controlled water temperature. Warm water softens the glue, and one pass of the hands makes a perfect seal. The machines will dispense tapes one to three inches wide in rolls up to nine inches in diameter. Operate on 115-volt, 60 cycle, A.C. Approved by Underwriters' Laboratories. Write Marsh Stencil Machine Co., Belleville, Ill.

◆ ◆ ◆

Recognizing the need among commercial transport operators for a more versatile cargo cooler, the Rue R. Elston Company, Inc., 1050 33rd Ave., Minneapolis 14, Minn., has made their standard line of dry ice cargo coolers available as completely portable units. Model P-300 is designed for truck bodies 18 feet or less, and has a dry ice storage capacity of 300 pounds. Models P-450 and P-600 are designed for trailer equipment and have storage capacities of 450 and 600 pounds, respectively. Cooling rate for each model is 450 cubic feet per minute per fan. The coolers can be mounted to suit operator's convenience, and can be manually or thermostatically controlled. Special units custom-built to specifications.

◆ ◆ ◆

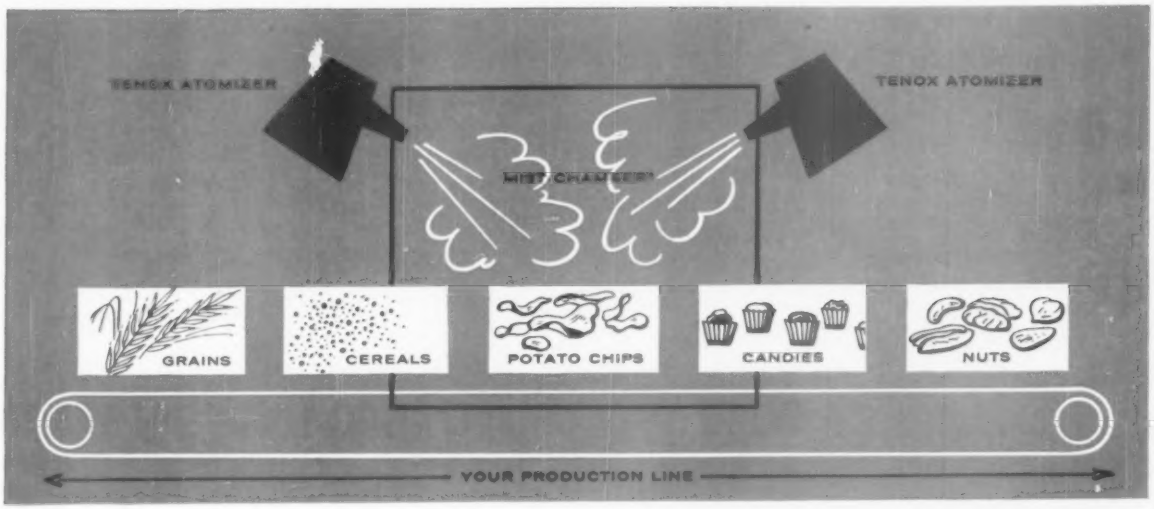
Development of a **continuous food freezer of unprecedented versatility,** which can freeze thousands of wrapped food packages an hour, was announced by York Corp., York, Pa. Incorporating mechanized conveyor equipment manufactured by Union Steel Products Co., Albion, Mich., the York-Union Continuous Food Freezer is the first completely automatic equipment able to freeze foods of varying types and sizes simultaneously. A typical York-Union freezing tunnel 60′ in length, 14′ wide, and 11′ high could freeze each of the following quantities of food in an hour: 3720 half-gallon or 9300 pint packages of ice cream, 3570 small meat pies, 5360 small fruit pies, 3560 loaves of bread, 5955 pullman rolls, and 2390 whole 2¼ pound chickens. Through integration of

(Continued on page 56)

NEW! Simple, economical spray treatment extends shelf life of

- grains
- cereals
- fried foods
- candies
- nuts
- many other foods

requiring the protection of antioxidants



*TENOX mist chamber can be constructed of plastic and conveniently installed at almost any point on your production line.

Now, many food products such as grains, nuts and cereals, can benefit from Tenox, the same antioxidant that has proved so successful in stabilizing fats and oils. A new technique, developed by Eastman, provides a simple method of applying Tenox directly under controlled conditions. The treatment involves passing the food through a mist chamber into which a Tenox solution is sprayed. The Tenox coats the food, effectively protecting against rancidity and extending shelf life.

The development of this economical technique is just one more example of Eastman's leadership in food-grade antioxidants. Eastman is the leader in volume, in experience, in accumulated data...and has the widest range of antioxidants available.

Investigate the possibilities of incorporating this new treatment in your plant. For more information, write: EASTMAN CHEMICAL PRODUCTS, INC., a subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Tenox

Eastman food-grade antioxidants

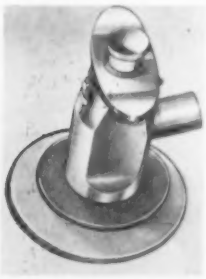
SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; St. Louis; Houston. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle. **Canada: P. N. Soden, Ltd.,** Montreal, P. Q.; Toronto, Ontario.

(Continued from page 54)

the unit into food processing production lines, important materials handling economies are effected, as wrapped products can be frozen quickly and moved into frozen storage without a hand touching the package.

◆ ◆ ◆

A simple, sanitary liquid food dispensing faucet designed and manufactured in accordance with U. S. Public Health Service and local health authority requirements, has been developed by Economy Faucet Co., 12 New York Ave., Newark 1, N. J. Model J008 faucet is specially designed for hot and cold food carriers and for drink dispensing equipment used by airlines, railroads, steamships, hospitals, etc. There are no crevices to trap dirt, or exposed pipe threads to collect contaminants. Withdrawing a lock pin—without tools—permits the faucet to be disassembled for cleaning, without disturbing piping connections. Shut-off is automatic and positive, eliminating after-drip. Faucet is machined from solid brass bar stock and is heavily chrome plated. Neoprene seals keep beverages odorless and assure tight closures. Available for cold or hot liquids in standard sizes.



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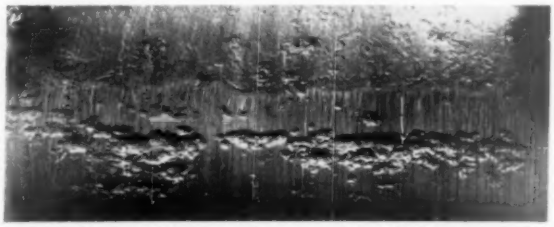


The photograph illustrates the power of rubber linings, properly specified and applied, to prevent corrosion. In this case, hydrochloric acid during a 15-year period ate from the outside-in right through a heavy gauge steel tank (due to spillage) but stopped when it reached the vessel's inner rubber lining. Moreover, from the inside, the rubber lining was found to be in excellent condition. For further information, write MW Protective Coatings Division of Metalweld, Inc., Philadelphia, Pa., c/o F. P. Walther Jr. and Associates, Inc., 2079 Wantagh Ave., Wantagh, N. Y.

◆ ◆ ◆

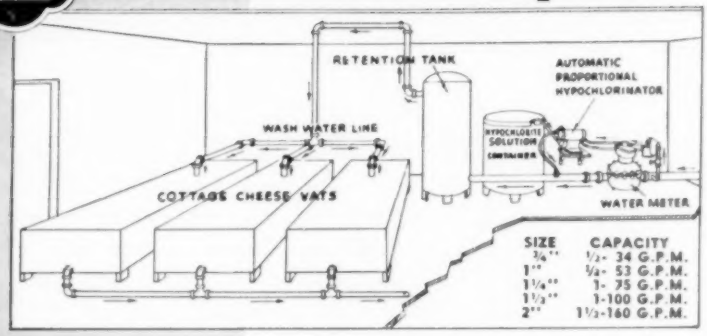
A new Micro-Fernbach flask, made of borosilicate glass in 3 small sizes—5, 10, and 25 ml.—has been introduced by Kimble Glass Co., subsidiary of Owens-Illinois Glass Co., Toledo, O. Broad base provides stability, and thick walls and reinforced lips withstand rough usage. To provide better illumination of photosynthetic organisms, special Neutraglas caps are provided. The flasks are especially useful in mi-

(Continued on page 58)

New! KLENZADE Chlorination System

FOR COTTAGE CHEESE WASH WATER

Protects Against Water-Borne Contamination



LOW FIRST COST
LOW CHEMICAL COST

The Klenzade System of in-plant water chlorination using an automatic and proportional Chem-O-Feeder offers wide latitude in application. It combines low first-cost, low chemical cost, as well as convenient "spot" location. The Chem-O-Feeder injects a predetermined ppm of Klenzade XY-12 Liquid Sodium Hypochlorite into the water supply line, independent of flow rate or water pressure variations. Both feeder and chlorine supply occupy small space and can be placed virtually anywhere in the plant.

Water chlorination is becoming more and more important for cottage cheese wash water. It destroys water-borne bacteria . . . preventing contamination of product and equipment . . . and extends the shelf life of the product.

The Klenzade System of Water Chlorination is simple to install and operate. No skilled operator is required . . . no gas risks . . . no maintenance of elaborate equipment. Supplies of Klenzade XY-12 Liquid Sodium Hypochlorite come in gallon jugs . . . easy to handle. Get the interesting facts now.

ON-THE-JOB SERVICE BY TRAINED TECHNICIANS

KLENZADE PRODUCTS, INC., BELOIT, WIS.

IMITATION CHOCOLATE AROME

An honest-to-goodness solution to your Chocolate Problem!

So true to the real chocolate flavor – and *so powerful* – is Givaudan's Imitation Chocolate Arome that extremely small quantities may be used to replace large amounts of cocoa in chocolate-type formulations.

Here is true economy – made possible by *honest-to-goodness* flavor in *high* concentration. In addition, the use of Imitation Chocolate Arome offers the advantages of a constantly reliable supply, stable in price and quality. It is soluble in vegetable oils and alcohol, and its versatility as a specialty should be considered in many flavor formulations.

Imitation Chocolate Arome is another Givaudan basic flavor contribution to uniform flavoring at lower cost. It can be used in combination with cocoa to enhance taste appeal in every type of preparation where chocolate flavor is required. We invite your inquiries.

Givaudan Flavors Inc.

330 West 42nd Street, New York 36, N. Y.

Branches: Philadelphia • Boston • Cincinnati • Detroit
Chicago • Atlanta • Seattle • Los Angeles • Toronto

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YOUR GUARANTEE
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PURITY, UNIFORMITY
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Behind the symbol of the Retort stands three generations of family pride and "know-how" in Essential Aromatics, natural and synthetic flavors, perfumer's specialties. Made in the West's most modern plant. The Retort is your guide to dependability.
F. Ritter & Co.
Los Angeles 39, California
Branch Offices in Principal Cities

(Continued from page 56)

erobiological assays of vitamins. The 10 ml. size is particularly adapted for Euglena and Ochromonas assays for vitamin B_{12}.

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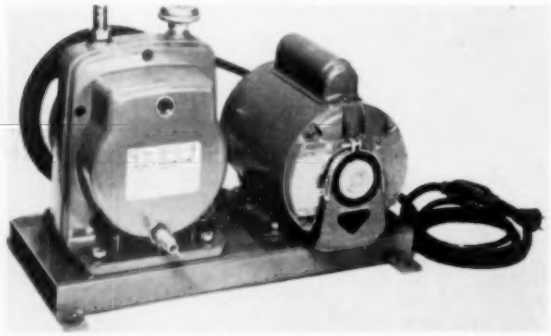


A completely new high vacuum pump, the Hyvac 2, pumps and delivers a free air displacement of 20 liters per minute. Practically vibrationless and noiseless, it can pump from atmospheric to ultimate pressure in approximately 5 minutes, and delivers a guaranteed ultimate vacuum of 0.1 micron. Pump and motor together measure only 10" by 15" over-all, with height of 11". Six motor arrangements to meet most voltage requirements are available. Price, with base and motor for 60 cycles, is $124.50. Write Central Scientific Co., 1700 Irving Park Rd., Chicago, Ill.

◆ ◆ ◆

A new flexible metal electrical wiring conduit which provides complete protection against moisture, dirt, oil, fumes, and chemicals is offered by Universal Metal Hose Co., 2133 S. Kedzie Ave., Chicago 23, Ill. Known as Type U208CB, the conduit features square locked construction, galvanized steel core, and a tough, waterproof synthetic cover. It is ideally suited for applications requiring flexibility for connections in tight places, for connecting wires on machinery constantly operating in excessive oil or moisture, and for applications of extreme vibration.

◆ ◆ ◆

Fire-Ban, a cement-type insulation coating, now is being specified for use with MMM, Inc.'s Styrofoam low-temperature pipe covering, Vapo-Wall. A single coat, as thin as $\frac{1}{8}$" (rated as incombustible by Underwriters Laboratories) can be applied for a total cost of 12c to 20c per square foot. Its smooth, durable, washable surface makes it ideal for food processing plants. The coating, a product of E. H. O'Neill Floors Co., is serviceable in temperatures as low as —100°F., and will not crack under such extremes. If patching is necessary, it can be done at below-zero temperatures without removing products from the cold-storage room. Further information on Fire-Ban and Vapo-Wall low-temperature pipe covering can be obtained from MMM, Inc., 1315 Hutchins St., Houston, Texas.

◆ ◆ ◆

Determination of wavelengths with accuracies to one part in one million can be obtained with the new model mercury^{195} source and microwave exciter unit available from Baird Associates, Inc., 33 University Road, Cambridge 38, Mass. Built for use in high dispersion interferometry, it makes determination of wavelengths much easier than with other techniques, and provides a higher level of accuracy in analysis. With the source and exciter, results 100 times more accurate than standard meter methods of measurement can be achieved. The mercury^{198} source is a fused quartz electrodeless lamp, 6 mm. in diameter and 14 cm. long, utilizing about 0.4 mg. of mercury^{198} prepared by transmutation of gold in an atomic pile. Argon is used as a buffer to enhance mercury excitation. The exciter is a portable unit, operating at a wavelength of 12.2 cm. in the 2400-2500 megacycle band, from a 60 cycle, 115 volt A.C. power source.

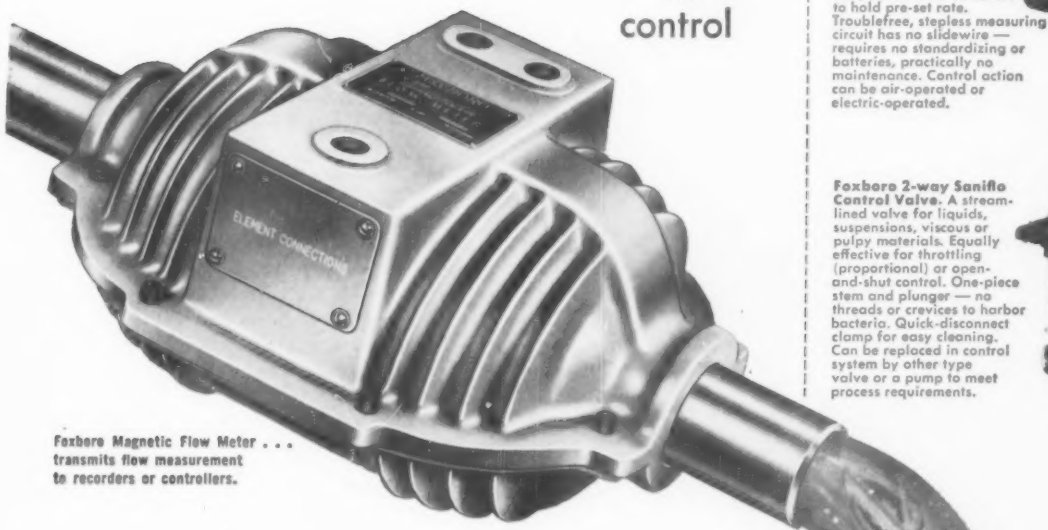
◆ ◆ ◆

The best way to get more material into undersized storage areas is to cut warehouse aisle widths drastically and stack higher. All you need to do the job is a fork truck that will turn "on a dime" and stack ton-and-a-half loads as high as 14½'. Lewis-Shepart Products, Inc., Watertown, Mass., points out that many companies have realized tremendous savings by switching from 12- to 8- and 6-foot aisles through use of narrow-aisle equipment. The narrow-aisle truck is possible to build only because it is powered by com-

(Continued on page 60)

New possibilities for continuous processing!

...with Foxboro sanitary proportional flow control



Foxboro Magnetic Flow Meter . . . transmits flow measurement to recorders or controllers.

You no longer have to discard new ideas in continuous process design for want of adequate flow control! Foxboro now provides the first complete sanitary proportional flow control system ever available.

Heart of this system is the Foxboro Magnetic Flow Meter. It has proved highly successful in measurement of widely varied food products including beer, tomato products, apple juice, and grape juice. And it's equally applicable to many others, such as egg yolks, wine—even molasses! It measures *magnetically*, with no flow interference, no pockets, crevices, or projections to collect residue or contamination. And its high accuracy is sustained, despite variations in conductivity, density, and viscosity.

The Dynalog Controller and the Saniflo Valve complete the system . . . offer a complete sanitary control "package". Send us your flow control problem. Write **The Foxboro Company, 354 Norfolk St., Foxboro, Mass., U.S.A.**

A complete, sanitary proportional flow control package

Foxboro Magnetic Flow Meter. Accurately measures the flow of virtually any liquid except non-conductors like chocolate, fats and oils. Installs easily in the line like any equivalent length of pipe. No taps, seals, purges, meter runs, or straightening vanes required. Connects by 2-conductor cable to remote Dynalog Controller.

Foxboro Dynalog Recording Controller. Responds instantly to changes in volume flow, initiates fast, accurate valve action to hold pre-set rate. Troublefree, stepless measuring circuit has no slidewire — requires no standardizing or batteries, practically no maintenance. Control action can be air-operated or electric-operated.

Foxboro 2-way Saniflo Control Valve. A streamlined valve for liquids, suspensions, viscous or pulpy materials. Equally effective for throttling (proportional) or open-and-shut control. One-piece stem and plunger — no threads or crevices to harbor bacteria. Quick-disconnect clamp for easy cleaning. Can be replaced in control system by other type valve or a pump to meet process requirements.

FOXBORO
REG. U.S. PAT. OFF.

SANITARY FLOW CONTROL

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

from the
WORLD OF YESTERDAY

to the
MANUFACTURING
PLANTS OF TODAY

Pyramid
BRAND
Spice oils

The finest spice oils can be recognized by the Pyramid Brand . . . the peak of quality at economy prices.

P&S experts, located in buying markets throughout the world, accept only the finest grades at the proper buying seasons.

Upon arrival here, they are reexamined and carefully analyzed by P&S technicians who properly evaluate them for meeting the needs of our discriminating American market.

Ask for the best . . . ask for "Pyramid" in these and many other oils:

ANISE	CLOVE	NUTMEG
BAY	CORIANDER	PEPPER
CARAWAY	DILL	PIMIENTO
CARDAMON	GINGER	SAGE
CINNAMON BARK	MARJORAM	THYME

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INCORPORATED
667 WASHINGTON ST., NEW YORK 14, N. Y.
Offices: Chicago, Ill.; Cinn., Ohio; Los Angeles, Calif.; Toronto, Can.
Plants: Teterboro & Guttenberg, N. J.; Culver City, Calif.; New York, N. Y.

(Continued from page 58)

pact electric storage batteries, the company stated. Among advantages claimed are extreme safety, low maintenance cost, easy operation, and freedom from fumes.

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Whether it's grain, cheese, or anything else that contains moisture, the new low-cost Aladin II Moisture Meter quickly ascertains how much water the product contains, and does it accurately. Plug it in, place a sample on the test tray, flip the switch, and the percentage of moisture content shortly appears on the dial. Operating on the infra-red principle, accuracy is assured. No separate sample weighing on a balance, no conversion charts or temperature corrections are necessary as final percentage moisture content is read directly on the instrument dial—from ½% to 99%. Write Klock, Inc., 385 E. Green St., Pasadena, Calif.

◆ ◆ ◆

Highlighting a group of **new, sanitary drum pumps** introduced by Mallet & Co., Inc., 601 E. General Robinson St., Pittsburgh 12, Pa., is the heavy-duty, electric Mallet Sanitary Drum Pump which can transfer such ingredients as compound greases, jelly, corn syrup, and other heavy food products at rates up to 25 pounds per minute without waste and contamination. Materials are pumped quietly in a steady stream, and flow begins immediately since priming is not necessary. Pump and drum of ingredients may be placed on a scale and the contents then emptied in any increments of weight desired. The pump is constructed of stainless steel and aluminum. It is mounted on a lid which will cover any 55-gallon open-style steel drum, and is available also for use with odd-size drums. It is not necessary to clamp lid to drum for efficient operation.

(Continued on page 62)

NOW AVAILABLE

A revised edition of **Information and Suggestions for Authors** was issued in January 1956. Copies are available to prospective authors of **Food Technology** or **Food Research** papers by applying to

THE EDITOR
11606 SOUTH BELL AVENUE
CHICAGO 43
ILLINOIS

The 1956 Institute Directory is available to members at $2.00 per copy. Order from Institute of Food Technologists, 176 West Adams Street, Chicago 3, Illinois.

PRIZE-WINNING BUTTERMAKERS PREFER DIAMOND CRYSTAL FLAKE BUTTER SALT!

MEMO
FROM WILLIAM FOSTER

Jim --

It looks like these Diamond Crystal people make a salt with just the right purity and grain size for <u>every</u> purpose.

Don't you think it would be a good idea to find out how Alberger Salt can help improve our operation?

Bill

Mr. Donald Hedding, of the Hillsboro Cooperative Creamery Co., Hillsboro, Wis., First Prize Winner for Sweet Cream Butter in the 1954 National Butter Scorings at the National Dairy Cattle Congress, Waterloo, Iowa. His butter won the same award in 1950. In both 1949 and 1950, Donald Hedding's sweet cream butter won First Prize in all classes at the Wis. State Fair.

rystal Flake Butter Salt for over 10 years," says prize winner Donald Hedding, "because Diamond Crystal's 'soft flakes' consistently do the best job in buttermaking of any salt I've ever seen! I'm sold on the way it dissolves quickly and completely in butter . . . leaves no grittiness. Diamond Crystal Flake Butter Salt never requires extra-long working which can produce mottled, sticky butter. It has a pure salt flavor that never imparts a strong, brackish flavor to butter. I've seen what it can do," says champion Donald Hedding, "and that's why it's my choice!"

Prize-winning butter is the result of many factors—skill born of long experience, painstaking care, good equipment and quality ingredients.

Diamond Crystal Flake Butter Salt helps you make better butter because:

- **It's the only Butter Salt made by the exclusive Alberger Process of refining which produces unique, quick-dissolving flake crystals!**
- **It's pure—highest uniform purity assures true salt flavor!**
- **It's uniformly sized—precision screening produces flakes that are just the right size and solubility for good buttermaking!**
- **It's clean—the lowest insoluble content of any butter salt!**
- **It's low in heavy metals—less than 1.5 parts per million of pro-oxidants copper or iron!**

DIAMOND CRYSTAL FLAKE BUTTER SALT

America's Largest-Selling High-Grade Butter Salt!

For further information, write to: Dairy Dept., Diamond Crystal Salt Co., St. Clair, Michigan

more Tang
for your flavor dollar!
with B-CAP*
A SYNTHETIC
BITE PRINCIPLE
Suggested as an ingredient in prepared meats, sauces, soups, dressings, or in any product where a pepper-like bite is desirable.
• Controlled bite • Soluble
• Easily blended • Cuts cost
Send for a Sample and Data Sheet.
*Beta-Cinnamylideneacetoyl piperidide
EVANS CHEMETICS, INC.
250 East 43rd Street • New York 17, N. Y.
Phone: MUrray Hill 3-0071

(Continued from page 60)

. . . the literary corner

"What's New in Food and Drug Research" for January, 1956, features enlightening short articles on the improved frozen orange concentrate available today, status of animal feeds laced with antibiotics (". . . the efficiency and economy of mass medication of flocks and herds by means of drugs added to the feed has catapulted the feed manufacturer into an unfamiliar role as a purveyor of drugs . . ."), loss of essential nutrients during storage of the basal diet in toxicological feeding tests, and the impact of radiation on the food technologists' horizon (". . . that the future holds promise of major developments appears to be a safe prediction, although authorities differ widely on how imminent and how big the impact will be . . ."). Publication is by Food Research Laboratories, Inc., 48-14 33rd St., Long Island City 1, N.Y.

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A new brochure on corrosion proofing materials and techniques, containing detailed information on cement mortars, interliners for masonry construction, and protective coatings and linings for surface treatment, is offered by Pennsylvania Salt Mfg. Company's Corrosion Engineering Department. Installations surveyed include linings in acid concentrators, stacks, pickling tanks, brick and tile floors for the food processing and chemical industries, as well as sumps, pits, and trenches for handling industrial wastes. Write the company at 3 Penn Center Plaza, Philadelphia 2, Pa.

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"Oxygen in the air is food enemy number one," according to a newsletter recently distributed to home economists. Second of a series titled "FOODS IN GLASS NEWS—A Memo to Home Economists," the newsletters are sponsored by White Cap Co., 1819 N. Major Ave., Chicago, as part of the firm's consumer education program. The issue deals with the deteriorating agents food packers must combat.

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The 1956 catalog of Chemical Specialties Research Laboratories, Box 33, Ansonia Station, New York 23, N.Y., lists as available the analyses of over 1500 different chemical specialties. The firm, which also supplies monthly reports to subscribers, offers its services to specialty manufacturers who do not have the facilities to make an analysis, to check inexpensively an analysis, to save the chemist's time of running an analysis, or to compare analyses of various products. Catalog sent without charge.

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"High Voltage Electron-Beam Processing," an authoritative survey of radiation machines and their application in chemical processing, sterilization, and industrial research, is available free from High Voltage Engineering Corp., Cambridge, Mass. Sections deal with characteristics of various forms of radiation, efficiency of radiation processing techniques, details on power output, capacity, and comparative cost of the various radiation sources. Ask for Bulletin E.

. . . this is a Roentgen

◆ ◆ ◆

Copies of SEQUESTRENE Bibliography (1953-54) are available from Geigy Industrial Chemicals, Division of Geigy Chemical Corp., 89 Barclay St., New York 8, N. Y.

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A newly designed booklet, "Food Floor Facts," offered by The Atlas Mineral Products Co., Mertztown, Pa., contains indexed sections describing FURNANE Floors, a floor developed by Atlas specifically for installation in food plants.

◆ ◆ ◆

A European technical observation group is being set up by Armour Research Foundation of Illinois Institute of Technology to funnel ideas and techniques of potential value to participating U.S. firms. The plan enables small and medium-sized companies to keep abreast of European technological developments at less than the cost of one good researcher reports "Industrial Research Newsletter," January 1956, published by Armour Research Foundation, Technology Center, Chicago 16, Ill.

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Institute of Food Technologists

THE PROFESSIONAL SOCIETY OF FOOD TECHNOLOGISTS

The Institute of Food Technologists numbers among its active members leading scientists, technologists and engineers in the field of Food Technology.

The Institute invites your professional association with this select group of scientific and technological workers. Only those who are qualified by education, special training, or experience are extended this invitation.

Food Technology may be defined as the application of science and engineering to the production, processing, packaging, distribution, preparation and utilization of foods. Scientists, technologists and engineers engaged in Food Technology, executives, officials and supervisors under whose jurisdiction Food Technology operations are conducted, research investigators, teachers, and others working in the field of Food Technology, will find membership in the Institute worth many times its modest cost.

If you can meet the qualifications for membership, you owe it to yourself and to your business or profession to become a member.

OBJECTIVES

The Institute is a non-profit, professional, educational association to promote the application of science and engineering to the production, processing, packaging, distribution, preparation, and utilization of foods; it stimulates investigations into technological problems arising therein, it provides a medium for presenting and discussing the results of such investigations; it stimulates and provides means for the free interchange of technological information and ideas among food technologists; it promotes recognition of the role of food technologists in the technical direction of operations in these fields; all of these activities have the ultimate objective of providing better and adequate foods for mankind.

ORGANIZATION AND PROGRESS

Organized July 1, 1939, at Cambridge, Mass., with a membership of less than 100, the Institute has grown to more than 4,000 (1954). It is world-wide in scope, with members in North, Central, and South Americas, the Scandinavian countries, England, Holland, Germany, France, India, Australia, and New Zealand.

MEMBERSHIPS

Professional Members. Any person who is ethically qualified, and who has had training and experience in food technology, or any person who in the opinion of the Council is recognized as distinguished in the contributing sciences as they apply to foods, shall be eligible to be a Professional Member of the Institute. The minimum training which shall qualify a candidate for eligibility for Professional Member is, in general, graduation from a college, university, or similar institution in which he has majored in one or more of the sciences or branches of engineering associated with food technology. The minimum experience shall be three years experience in food technology. The Council may, at its discretion, waive any or all of the foregoing requirements in the case of a person who, thru long experience, has distinguished himself in the field of food technology.

Members. Any ethically qualified person, active in special or limited aspects of food technology, who is an administrator, director or executive under whose jurisdiction operations in food technology are conducted; or who is engaged in the dissemination of knowledge of food technology; or one whose work requires a general knowledge of the broad principles of food technology as it applies to the products, processes or equipment with which he or she is concerned; or one scientifically trained in and who has entered a career in food technology; shall be eligible to become a Member.

Student Members. Any ethically qualified person who has never been a Professional Member or Member of the Institute, who is registered as a student in an educational institution with at least Junior (third year) standing, who is a candidate for a Bachelor's or higher degree in one or more of the sciences or branches of engineering associated with food technology, shall be eligible for membership as a Student Member. This classification shall be his status only until the end of the calendar year in which he completes his schooling. When graduated and otherwise qualified as defined in the section on "Members," a Student Member may, upon application, be elected to Membership.

DUES

Professional Members and Members—$7.50 per year; Students—$2.50 per year. Dues include a subscription to FOOD TECHNOLOGY.

PUBLICATIONS

FOOD TECHNOLOGY, issued monthly, is the official journal of the Institute. It is published to advance the profession of food technology by disseminating the results of research and their practical application in industry. Contributors to its pages represent many fields of scientific and technological interest.

FOOD RESEARCH, published bi-monthly, is devoted to publication of the results of original investigations and occasional reviews in the fields of food and beverage technology, chemistry, and microbiology. FOOD RESEARCH is available to Institute members at the special rate of $7.50 per year.

REGIONAL SECTIONS

Where sufficient members (25 or more) live within commuting distance of a given point, a Regional Section may be established. Such Sections are able to hold meetings at more frequent intervals than the National group, thus affording the food technologists regular opportunities for an exchange of views and ideas with others in the area. There are presently 24 Regional Sections.

ANNUAL MEETINGS

Each year one of the regional sections acts as host to the Institute at an annual meeting. The program of this annual conference is designed to acquaint members with various phases of food production, processing and distribution, and to keep them abreast of current trends and technological developments. The speakers invited are those whose subjects will build a well-rounded program, of interest to the greatest number. Annual conferences are highlighted by exhibits of new equipment, processes and special ingredients.

AWARDS

The society administers the following awards:

NICHOLAS APPERT AWARD (Medal). Each year the Chicago Section of the Institute makes this award to a person whose contributions to the food industry make him distinguished and outstanding in the opinion of the national jury.

BABCOCK-HART AWARD ($1,000.00). The purpose of this award, made by the Nutrition Foundation, is to encourage contributions to FOOD TECHNOLOGY which will have an influence on the nutritional well-being of the general population.

FLORASYNTH FELLOWSHIP AWARD. $1,000 granted annually to a young man or woman under 35 years of age, engaged in senior undergraduate or graduate work, as a candidate for an advanced degree, in recognized educational institutions in the United States or Canada, which is conducting fundamental investigations for the advancement of Food Technology.

GENERAL FOODS FELLOWSHIP AWARDS. Three Fellowships will be granted annually—no more than two to the same educational institution for the same calendar year, but will be renewable upon application to and approval by the Awards Committee of the Institute for a maximum of three years, in order to provide for continuity of studies leading to a doctorate degree, if the candidate so plans. However, candidates, who plan only a year of research after obtaining the Bachelor Degree, or who plan to read for a Master's Degree, will not be excluded from these fellowship grants. Each Fellowship is worth approximately $4,000.

GERBER BABY FOODS POST-DOCTORATE FELLOWSHIP AWARD. This Fellowship to promote research in some newer phase of food technology is worth $6,000.00 per annum and may be renewed for an additional year.

SIX DECADES
OF SERVICE TO
FOOD TECHNOLOGISTS

60 years of specialized experience in the manufacture of powdered vanilla products

David Michael has long since mastered the special skills and techniques to create new and highly individual flavorings to fill any specific need, and have been the acknowleged leader in the vanilla field for 60 years.

Let us develop a custom-made flavor for your product in our laboratories and testing kitchen. Research is our keynote—let it work to your advantage!

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Suite 2204 • 203 N. Wabash Ave., Chicago 1, Ill.
CANADA
DAVID MICHAEL & CO., LTD.
801 St. Clarens Ave., Toronto

(Continued from page 62)

"So Sweet and Unrefined," a February feature article of *The N. C. A. Bulletin*, published by National Confectioners' Assn., 221 N. LaSalle St., Chicago 1, Ill., reports at some length on the ion exchange sugar developed by scientists at the USDA's Southern Regional Research Laboratory. The quality of this new grade of sugar reportedly makes it suitable for use without further refining in many food products, particularly candy and confections.

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In addition to other useful information, the Winter 1955-56 edition of *SeaKem Extracts*, published by Seaplant Chemical Corp., 63 David St., New Bedford, Mass., announced that Harvard Beet Sauce is one of the latest of a long line of sauces that have fallen under the enticing spell of Irish Moss (the company's product). Copies of a suggested formula for a superb HB Sauce are offered free-of-charge.

◆ ◆ ◆

New Detecto Heavy Duty Catalog No. 651 presents information on the company's dormant, portable, and bench scales. Also shown are illustrations of meat packing, motor truck, and dairy type scales. Write Detecto Scales Inc., 540 Park Ave., Brooklyn 5, N.Y.

◆ ◆ ◆

Twenty important scientific discoveries are described in a new 64-page booklet entitled "Accidental Scientific Discoveries," available free from Schaar and Company, 754 W. Lexington St., Chicago 7, Ill. Included are stories on the discovery of oxygen, iodine, crystallography, thiophene, dental amalgams, and others.

◆ ◆ ◆

Two models of Spence direct-operated water pressure reducing valves recommended especially for dead-end water service where flow is intermittent and subject to abrupt fluctuation, and also useful with such fast acting equipment as flushometers and snap cocks are described in a 4-page bulletin available from Spence Engineering Co., Inc., Walden, N.Y.

◆ ◆ ◆

Construction and operational details of a new induced draft cooling tower are described in special bulletin CT-56-1, available from Foster Wheeler Corp., 165 Broadway, New York 6, N.Y. In addition to a 3-dimensional wash drawing of a tower cell, the 4-page publication also includes perspective drawings of major equipment features. Materials of construction and operational features are covered.

. . . *meeting hall and conference room*

Results of stored product insect investigations will be discussed at the Tenth International Congress of Entomology, to be held in Montreal, Canada, August 17-25, 1956, when 1500 of the world's foremost entomologists—from over 60 countries—will review progress made in controlling destructive pests of raw and manufactured food products, forestry, human welfare, and other fields. The Congress will be held at McGill University and the University of Montreal. Host organization is the Entomological Society of Canada. Headquarters address for Congress information is Science Service Bldg., Carling Ave., Ottawa, Ontario, Canada.

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A Symposium on "Control of Corrosion in the Chemical Industry—The Proper Use of Metals and Alloys for Corrosion Prevention," sponsored by the Niagara Frontier Section of the National Association of Corrosion Engineers and the University of Buffalo, will be held May 9-10, 1956, on the University of Buffalo campus. The program is directed toward the "general practitioner" who requires factual, up-to-date information for the rapid solution of everyday corrosion problems. Contact Industrial Liaison Office, University of Buffalo, Buffalo, N.Y.

◆ ◆ ◆

The Instrument Society of America announces plans for a well-rounded program of technical sessions, clinics, and workshops in connection with its Eleventh Annual Instrument-Automation Conference and Exhibit (International) scheduled for New York City, September 17-21, 1956. For details, write Mr. Fred J. Tabery, Exhibit Manager, 250 W. 57th St., New York City.

. . . *building up and branching out*

Sunkist Growers Products, Ontario, Calif., has announced that Ungerer & Co., Inc., Fritzsche Brothers,

(Continued on page 66)

BUILDING BETTER "BODY" . . . . . for foods and drugs

For years, makers of candies, flavors, cough syrups, lozenges, lotions and other food, drug and cosmetic preparations have used Glycerine to provide humectant, demulcent or solvent action. Recent research with new thickening agents indicates that these properties of Glycerine will soon be extended to a whole new range of food and drug preparations.

Glycerine has been known for years to be compatible with conventional water soluble gums and gelling agents such as Gum Arabic and Karaya. New studies show that Glycerine is also compatible with a majority of the new synthetic gums. In most cases, Glycerine supplements the bodying action of these gums, and the resultant formulations are relatively unaffected by freezing and thawing.

Other fields, too, will benefit from this compatibility of Glycerine. Nontoxic lubricants are now possible. Important improvements in printing inks, grinding and polishing pastes, gasket seals—all making use of Glycerine's unique balance of properties—are promised.

The versatility that has won such wide acceptance for Glycerine in the past continues to open new doors to chemical progress. In paints, foods, pharmaceuticals, packaging . . . for tomorrow's surge of specialties . . . in new formulations, reactions and processes, nothing takes the place of Glycerine.

This balanced group of properties keeps Glycerine's usefulness growing

HYGROSCOPICITY • STABILITY •
SOLVENT POWER • VISCOSITY • NONVOLATILITY •
NONTOXICITY • TASTE • MW/HYDROXYL RATIO •

HUMECTANT •
CARRIER • SOLVENT • LUBRICANT • SOFTENER •
EMOLLIENT • ANTI-FREEZE • ALKYD BASE •

☑ CHECK AND SEND FOR TECHNICAL DATA

☐ 20-page booklet on Glycerine for product conditioning

☐ 8-page booklet on "Federal Specifications for Glycerine"

☐ 16-page booklet on Glycerine properties and applications

For your free copy of any or all of these booklets write: **GLYCERINE PRODUCERS' ASSOCIATION** • 295 Madison Ave., New York 17, N. Y.

SANITATION
starts with
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From start to finish of your processing operation, *Wallace & Tiernan In-Plant Chlorination* will keep your sanitation problems to a minimum by:

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Retarding bacteria growth

Greatly reducing offensive odors

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INCORPORATED
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I-46

(Continued from page 64)

Inc., and Dodge & Olcott, Inc., all of New York City, will represent the firm in the sale of Exchange Brand Lemon and Orange Oils.

◆ ◆ ◆

Beckman Instruments, Inc., has announced establishment of the Shockley Semiconductor Laboratory to develop and produce transistors and other semiconductor devices in the field of advanced electronics for automation. Headed by Dr. Wm. Shockley, inventor of the junction transistor, as director, the nucleus of the research team consists of Dr. G. S. Horsley, formerly of Motorola and Bell Laboratories; Dr. L. B. Valdes, formerly of Pacific Semiconductor, Inc., and Bell Laboratories; Dr. W. W. Happ, formerly of Raytheon Mfg. Co. and Sylvania Electric Products; and Dr. R. V. Jones, who has just completed training at the University of California, Berkeley. Quartered temporarily in Mountain View, Calif., the group will move into the new research and development center Beckman is building in Stanford Industrial Park for its Spinco Division and the Shockley Semiconductor Laboratory. Completion of the facility is scheduled for August 1956. Dr. Shockley was most recently director of transistor physics research at Bell Laboratories. During World War II, he served as director of research for the Navy's Anti-Submarine Warfare Operations Research Group, and was a consultant to the Secretary of War.

. . . for Shockley . . . a place in the sun . . . with Beckman

◆ ◆ ◆

Wm. J. Stange Co., 342 N. Western Ave., Chicago, Ill., purchased, effective January 3, 1956, American Spice Mills of Chicago. The latter will be operated as a Stange division with Mr. Thos. Gunning, former president, as manager. The acquisition enables Stange to offer food processors regular ground natural spice in addition to Stange's regular line of 50-A Micro-ground Natural Spice and Cream-of-Spice soluble and liquid seasonings.

◆ ◆ ◆

Continental Can Company's Metal Division has announced arrangements with Southern Pacific Company to acquire about 40 acres of industrial property in San Leandro, Calif., for future development. Definite plans for construction of new facilities commencing in 1957 are underway.

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Increased marketing activity to meet industry demands on the Atlantic and Pacific coasts has been announced by Moisture Register Co., Alhambra, Calif. Appointed as manufacturer's representative for the full Moisture Register line on the middle Atlantic seaboard is Energy Controls Co., Inc., with main offices in New York City and Philadelphia, and branch offices in Albany, Wilmington, and Baltimore. West Coast appointment went to E. S. Browning Co., Inc., of Los Angeles and San Francisco.

◆ ◆ ◆

Details of Olin Mathieson Chemical Corporation's plans to enter the aluminum industry with an initial investment of $120 million and with the world's first fully integrated aluminum plant were announced recently by Mr. Thos. S. Nichols, president. The new operation will mark the first time in the history of the aluminum industry when coal mined directly on the site is used to provide the large power requirements for the reduction of alumina to pig aluminum. The alumina plant will have a capacity of 230,000 tons per year. Capacity of the aluminum plant will be 60,000 tons per year. At first, only about 115,000 tons of alumina will be required for the aluminum plant, and the other 115,000 tons of surplus alumina will be available to the market. Most of the 60,000 tons of finished aluminum will be consumed by the Metals Division of Olin Mathieson. However, the Corporation will be both a buyer and a seller of prime aluminum in order to keep the fabricating facilities in balanced supply.

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Gifford-Wood Co., Hudson, N. Y., has acquired license and patent rights to manufacture and market the stainless steel series of Eppenbach wet mixing and homogenizing equipment — including Colloid Mills,

(Continued on page 68)

FLAVOR

YOUR "DOOR TO DOOR" SALESMAN

Your customer goes to the store and brings your food product home. Packaging, promotion or impulse buying may account for this first time sale. But you haven't really sold her — not yet! You've just *contacted* her. Only quality food with unique taste-appeal can be counted on to bring her back again and again —and keep those registers ringing. Flavor goes out of the store with your customer—it goes to the table and becomes in essence your personal "door to door" salesman. The final impression this salesman creates decides the ultimate fate of your product. Let the D&O Flavor Laboratories make your silent salesman, FLAVOR, the best you've ever had!

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Ac'cent®
BRAND
Pure Monosodium Glutamate

(Continued from page 66)

Homo-Mixers, and Agi-Mixers—widely used for over 30 years in such chemical processing industries as foods, pharmaceutics, cosmetics, protective coatings, heavy chemicals, and plastics. Gifford-Wood is setting up manufacturing facilities for Eppenbach equipment at its main plant in Hudson, N.Y. Direct inquiries to Mr. Patrick Orto, Gifford-Wood Co., Graybar Bldg., New York City.

◆ ◆ ◆

Acquisition of substantial additional capital, a move to larger quarters, and election of a new and expanded board of directors was announced by Products Development Corp., 80 Federal St., Boston, Mass., a pioneering firm of engineering, marketing, and production specialists who serve as new product consultants to industrial organizations. Mr. John F. Rockett, Jr., is founder and president of the company.

. . . *the human element*

Mr. E. Paul Orsay has been named sales manager for the flavor division of van Ameringen-Haebler, Inc., New York City. With the firm's Chicago branch since 1930, he has been active in food, beverage, and confectionery circles for 21 years, and has served the industry in various capacities as a member of IFT, American Association of Cereal Chemists, American Association of Candy Technologists, and the R & D Associates. He will head up Alva Flavors sales activities from flavor division headquarters at the Elizabeth, N.J., plant.

◆ ◆ ◆

. . . Siegel of Felton and FEMAC

Mr. Mike Siegel, a 10-year veteran of the Felton Chemical Company's Los Angeles branch, has been elected president of the Flavoring Extract Manufacturers Association of California.

◆ ◆ ◆

The Flavor Laboratory of Arthur D. Little, Inc., honored **Mr. Loren B. Sjöström,** head of the laboratory, with a luncheon on January 13 to celebrate his 20th anniversary with the company. IFT member Sjöström, a noted food researcher who is co-developer of the Flavor Profile method, is one of the founders of the Flavor Laboratory. Under his leadership, staff and work volume have more than tripled since its founding in 1949.

◆ ◆ ◆

. . . after 5 years . . . a branch for Ingham

Mr. Robert H. Ingham has been appointed manager of the New York Sales Branch of The Creamery Package Mfg. Co., 500 Fifth Ave., New York City. After graduation from Michigan State University with a B.S. in food technology, IFT member Ingham spent considerable time working in the production and research fields. He joined Creamery Package in 1950.

◆ ◆ ◆

Mr. Geo. L. Foehringer, senior chemical engineer, has been named supervisor of the monosodium glutamate plant of A. E. Staley Mfg. Co., Decatur, Ill. Staley is the world's largest processor of corn and soybeans. Mr. Foehringer, 34, began with the firm in 1948.

◆ ◆ ◆

Mr. Harold L. Janovsky has been appointed director of the Flavor Division of Dodge & Olcott, Inc. An industry veteran of 21 years, well known for his published works and association activities, IFT member Janovsky has been, for the past 5 years, technical director of Virginia Dare Extract Co. He has held executive technical positions with Aroscent, Inc., and Seeley & Co., Inc. He will work from the firm's executive offices and laboratories at 180 Varick St., New York City.

. . . Janovsky savors D & O's flavors

◆ ◆ ◆

Mr. Jos. B. Kerr, assistant sales manager for the Eastern Operation of Food Machinery and Chemical

Corporation's Canning Machinery Division at Hoopeston, Ill., retired in December upon completion of 42 years' service with the company.

◆ ◆ ◆

Mr. Donald L. Rheem has been elected chairman of the board of Rheem Mfg. Co. Formerly executive vice president, Mr. Rheem was a co-founder of the firm. The board of directors also has elected **Mr. A. L. Walker** executive vice president. Mr. Walker, a director of the parent company, will continue to serve as vice president in charge of Rheem International. In another new appointment, **Mr. Emerson S. Ronk** has been named vice president of Administration, a newly created post. Both Mr. Walker and Mr. Ronk will serve on Rheem's executive committee.

◆ ◆ ◆

. . . more seniority for Spinco's Turner

Mr. Geo. K. Turner has been named chief electronics engineer at Spinco Division, Beckman Instruments, Inc., Belmont, Calif. He was most recently a senior engineer in the Military Electronics Division of Hycon Mfg. Co., Pasadena, Calif.

◆ ◆ ◆

Mr. Lloyd R. McIntosh has been appointed general manager at High Voltage Engineering Corp., Cambridge, Mass. Head of the company's production division since 1950, he will coordinate production, engineering, development, test, and installation activities for the firm, makers of Van de Graaff and linear supervoltage particle accelerators.

◆ ◆ ◆

. . . von Fischer's decision gladdens Glidden

Dr. Wm. von Fischer, for the past 8 years head of the department of chemistry and chemical engineering at Case Institute of Technology, has been appointed coordinator of research and development for The Glidden Co., Cleveland, O. An outstanding authority in chemistry, he is editor of *Paint and Varnish Technology*, co-editor of *Organic Protective Coatings*, and the author of numerous technical articles. He will assume his new position at the close of the present academic year.

◆ ◆ ◆

Mr. Chas. G. Mortimer, president of General Foods Corp., received the honorary degree of mechanical engineer from Stevens Institute of Technology, Hoboken, N.J., on February 3. The award was made on the recommendation of Mr. Mortimer's classmates at Stevens, the class of 1922, in recognition of his work to improve marketing methods in the packaged

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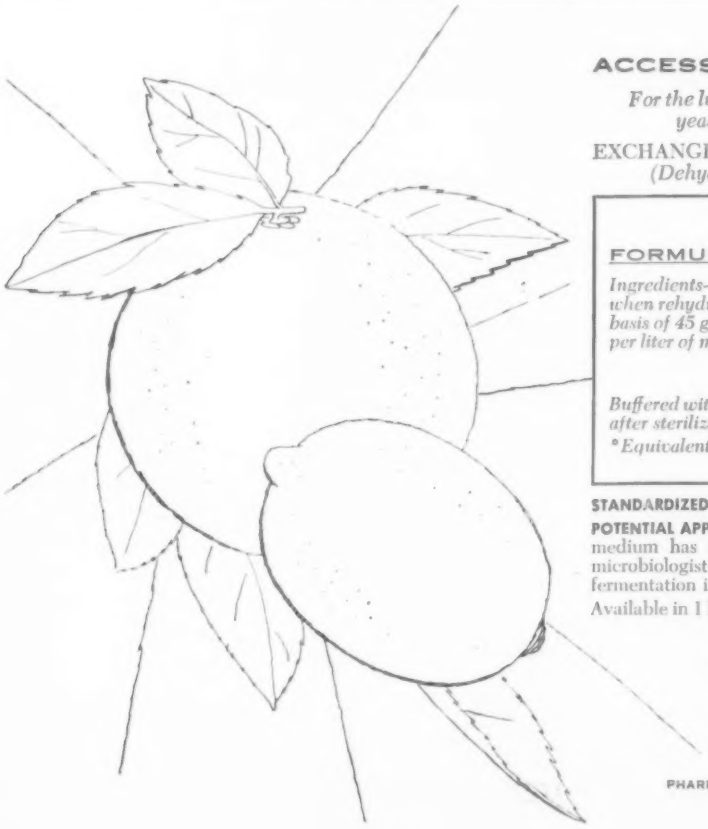

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(Dehydrated) a Complete Culture Medium

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Ingredients—when rehydrated on basis of 45 grams per liter of medium.

Orange juice serum solids	12.6g*
Agar (dry basis)	15g
Peptone	10g
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Reducing sugars, total	8g
Sucrose, total	6g
Cysteine hydrochloride	0.001g

Buffered with 0.2 to 0.6g K_2HPO_4 to provide pH 5.5 ± 0.05 after sterilization.

**Equivalent to 100 ml 12° Brix orange juice serum.*

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First results of the industry campaign are now coming in. Gulf Power Company has reached 87.3% employee participation... Utah Power and Light employees have enrolled 69.6% . . . Wisconsin Electric Power reports 69.8% . . . Wisconsin-Michigan Power Company, 62% . . . Wisconsin Public Service, 57.6% . . . Lake Superior District Power, 52%.

Has every employee in *your* company been offered an opportunity to enroll in the Payroll Savings Plan? If not, communicate with Savings Bond Division, U.S. Treasury Department, Washington, D.C. Your State Sales Director will show you how easy it is to conduct a person-to-person canvass.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

THE INSTITUTE OF FOOD TECHNOLOGISTS

(Continued from page 69)

food field. His classmates also commended Mr. Mortimer for his leadership in the War Advertising Council which he helped organize. Now called the Advertising Council, the agency is still conducting public service programs.

• • •

Dr. Jos. R. Haun, formerly plant physiologist for weed control research with the Grasselli Chemicals Department of Du Pont, is the new director of the newly established weed control division of Insect Control and Research, Inc., 6601 Johnnycake Rd., Baltimore 7, Md. The division will conduct custom research projects on adaptation of chemicals or by-products for herbicidal uses, and will offer service and consultation on weed control problems for industry and government.

• • •

. . . a salty assignment for Reith

Mr. Howard E. Reith has joined International Salt Co., Scranton, Pa., as sales engineer, and will work from the company's Philadelphia and Baltimore offices. IFT member Reith previously was associated with the Diamond Alkali Company as technical service representative. His responsibility included the entire food industry.

• • •

Miss Jo Parks, for more than 15 years in her profession, has established a service as technologist for food processors at 659 Peachtree St. N. E., Atlanta, Ga. The service covers development of new products, re-development of present formulas, conversion of problem by-products into saleable foods, and testing of competitive goods. Miss Parks is a member of IFT.

• • •

. . . Filz's ideas will pay at Ocean Spray

New director of research for National Cranberry Association is **Mr. Wm. F. Filz** of Hood River, Ore. The research laboratory is located in Hanson, Mass., headquarters for the national cooperative's 7 processing plants. IFT member Filz, who took his M.S. in food technology from Oregon State College, is setting up a pilot cranberry plant at National Cranberry, and his first objectives will be product development and quality control.

• • •

Appointment of **Mr. Lon Feldbrugge** as an assistant editor on the staff of *Food Processing* magazine, was announced by Mr. Howard P. Milleville, editor. Before joining Putman Publishing Co., Mr. Feldbrugge was a projects engineer with Colgate-Palmolive Co. Previously, he was a staff member of the Wyandotte Chemicals Corp.

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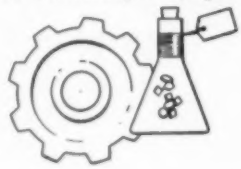

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AVAILABLE: Food Technologist (Cal., 49). At present Assistant Production Manager Citrus Processing plant abroad. Experience quality control, production supervision in Citrus Juices, squashes, drinks, other by-products; also tomato processing. Desire suitable position in the U. S. REPLY BOX 453, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

WANTED: Food Technologists and Chemists with advanced degrees and experience for research and development positions in an interesting and expanding food industry. Only superior type personnel will be considered. REPLY BOX 454, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

WANTED: CANNED FOOD TECHNOLOGIST. Experienced in quality control of vegetable and fruit canning operations. Excellent opportunity for aggressive college graduate with 5 or more years experience. Control involves multi-plant operation of progressive Eastern canner. REPLY BOX 462, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

FOOD TECHNOLOGISTS

2 Food Technologists for major food processor in (a) Product Development—for experienced man. Prefer Ph.D. (b) Staff Control—responsible for development and administration of quality control programs for multi-plant operations. Experience required. Salaries dependent upon qualifications. REPLY BOX 463, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

WANTED: Man with good background in Food Technology and related fields to work with laboratory in product development and technical service. Large organization concerned with variety of food materials. Advanced degree desirable. Location Chicago area. REPLY BOX 464, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

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WANTED: Bacteriologist with Bachelor's or Master's degree to assist project supervisor in fermentation laboratory. Good background in chemistry desired. Location Chicago area. REPLY BOX 465, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

AVAILABLE: Food Technologist, (B.S.), graduate June 1956, 27 yrs. old, with 6 yrs. electronic background, (Navy ET2). Desires position in food industry requiring electronic application, preferably in western part of country. REPLY BOX 466, Institute of Food Technologists, 176 W. Adams St., Chicago 3, Ill.

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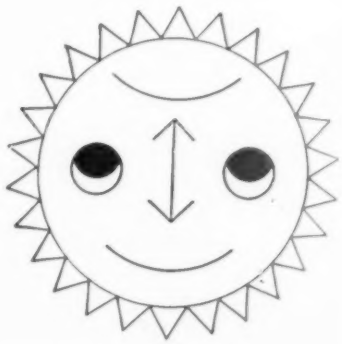

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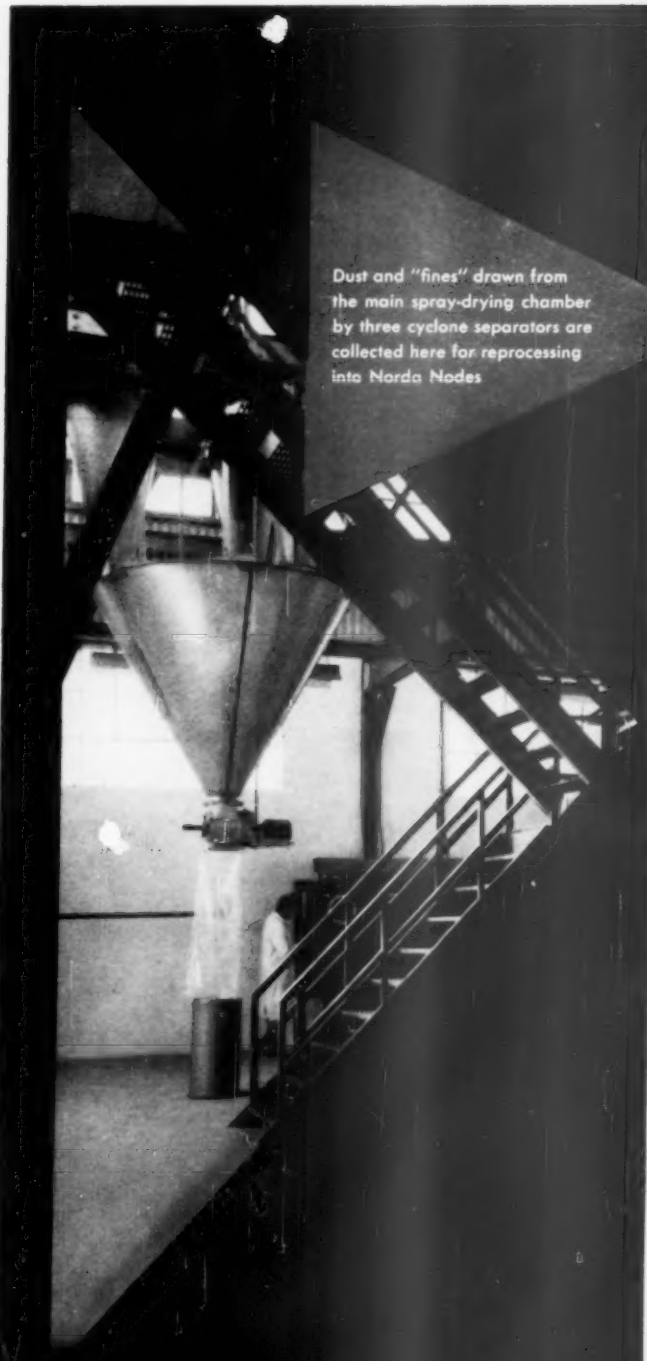

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